FLIGHT

FAIREY

GANNET

THE FAIREY AVIATION COMPANY LIMITED · HAYES · MIDDLESEX · ENGLAND

Sperry weather

SPERRY
GYROSYN COMPASS

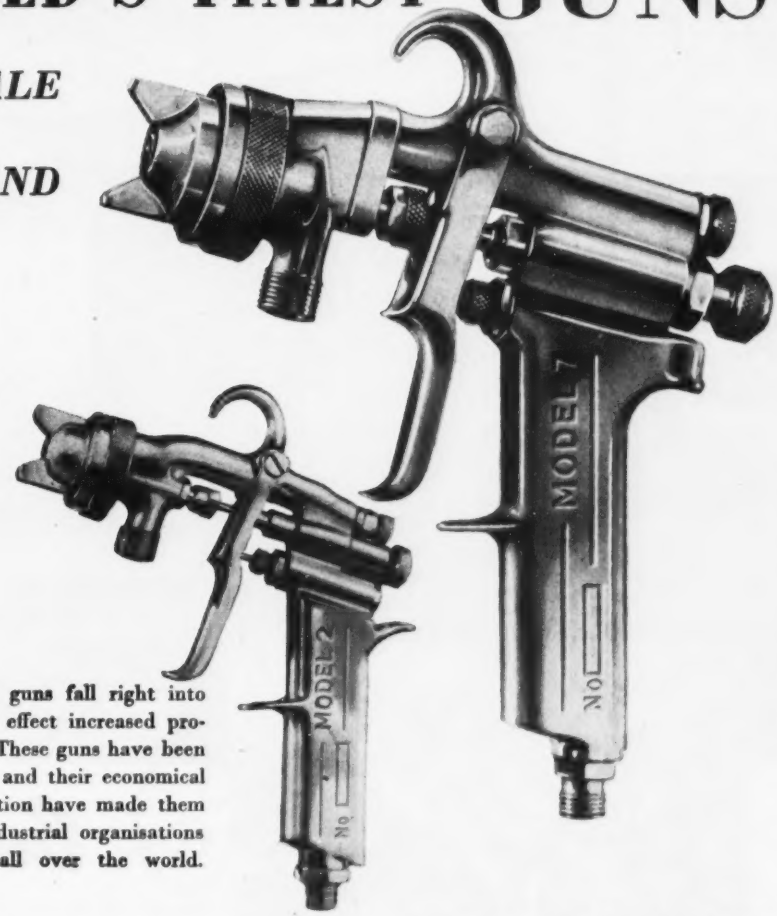
SPERRY ELECTRIC
GYRO HORIZON

YOUNG

THE WORLD'S FINEST GUNS

FOR LARGE SCALE AIRCRAFT, AUTOMOBILE AND INDUSTRIAL PRODUCTION

Deliveries stepped up by over 150%. Our 100% service will assist you to step up* YOUR *production by 150% or more.



The A.I.D. Model 2 and Model 7 guns fall right into line with the need of industry to effect increased production and saving of man-hours. These guns have been put to every known practical test, and their economical performance and mechanical perfection have made them the outstanding choice of great industrial organisations and Government Service Depts. all over the world.

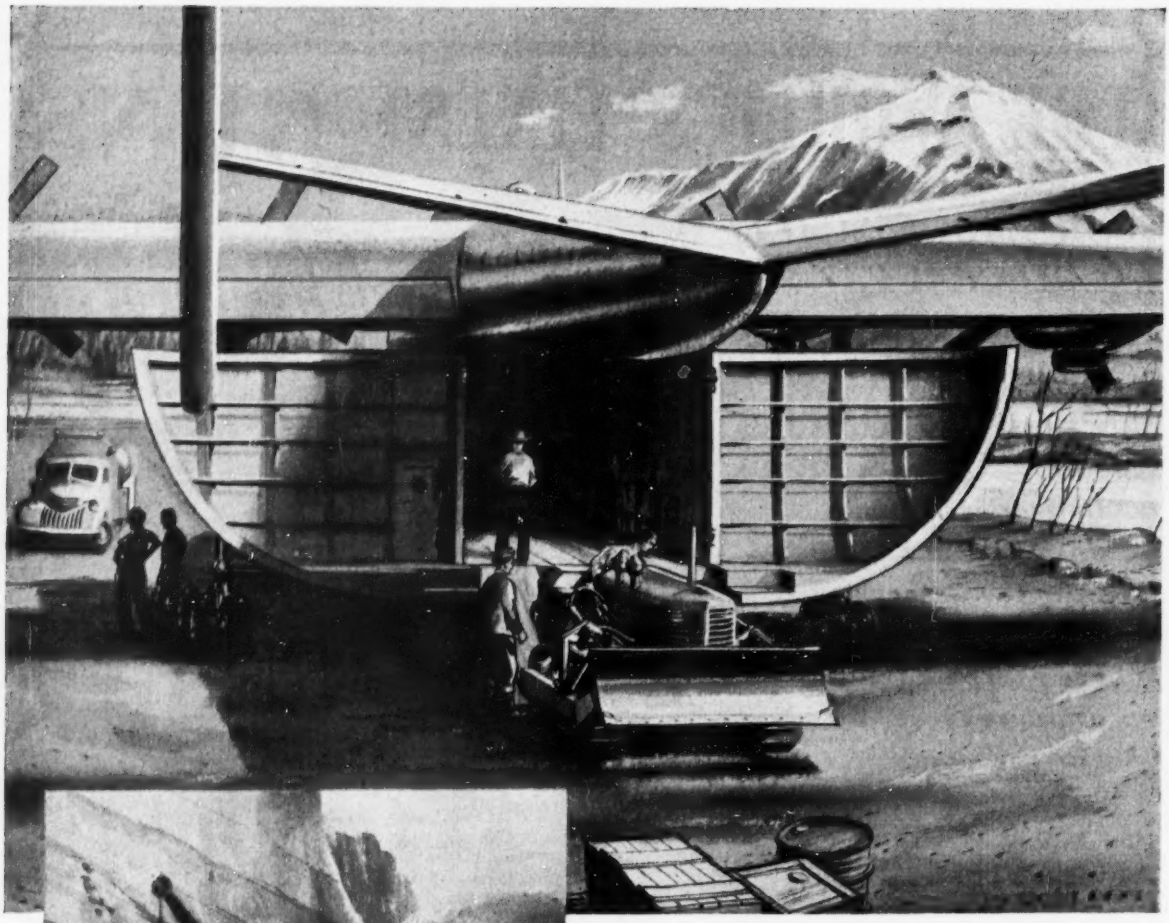
AND THE WORLD'S FINEST *SERVICE*

No service can excel the A.I.D. INSTANT RESERVE REPLACEMENT SERVICE which ensures 100 per cent. man-hour efficiency every hour of every day — New or reconditioned guns are exchanged instantly for your worn or damaged guns. A.I.D. not only supply guns, but EVERYTHING behind the gun. Whether your needs are large or small do not hesitate to request the services of our technical organisation.

AID

CONTRACTORS TO THE WAR DEPARTMENT OF THE U.S.A. THE BRITISH AND COMMONWEALTH GOVERNMENTS

Sole Manufacturers: AIR INDUSTRIAL DEVELOPMENTS LIMITED, Aidspray Works, Shenstone, nr. Lichfield, Staffs, England. Phone: Shenstone 341/5. Grams: Aidspray, Shenstone. London, 28 South Molton Street, W.1. Phone: Mayfair 6318. Grams: Aidspray, Wesdo. Scottish Office, 90 Glasgow Road, Paisley. Phone: Paisley 3175. CANADA, 350 HILLCREST AVENUE, WILLOWDALE, nr. TORONTO, ONTARIO. PHONE: BALDWIN 1/2677.



FOR *Bulk* TRANSPORT

Heavy machinery can be loaded aboard the UNIVERSAL more easily than onto a railroad freight car. Its large unrestricted hold and three additional compartments are ready to take up to twenty-two tons of equipment, stores or produce—and forty-two passengers.

Its rugged construction, its four-engined safety, its ability to operate from undeveloped airfields spell suitability for big development projects with which no other transport can compete.

In Canada, birthplace of practical air-freighting, there are many jobs waiting for the UNIVERSAL.

Civil Engineers, Mining Executives and Constructional Contractors—in fact anyone with a transport problem—are invited to enquire further into the capabilities of the

Universal

Blackburn and General Aircraft Limited, Brough, E. Yorks

ELECTRIC EQUIPMENT

by

B T-H

is installed on the

COMET

JET-PROPELLED AIR-LINERS

B T H designed, developed, and supplied the complete electric power system

SPECIFY B T H EQUIPMENT

THE

BRITISH THOMSON-HOUSTON

COMPANY LIMITED, COVENTRY, ENGLAND

Member of the AEI group of companies

A4465N

The

LARGEST

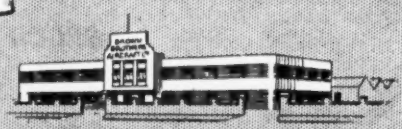
manufacturers and stockists of

STANDARD PARTS

A.G.S.
B.S.S.
S.B.A.C.

Brown Brothers (AIRCRAFT) Ltd.

. . . and a **SALES AND SERVICE ORGANISATION** to ensure that your demands are dealt with promptly and efficiently



Aircraft and General Engineers
HOUGHTON ROAD · NORTHAMPTON

Telephones: Northampton 4940. *London: Clissold* 1280. *Telegrams: Imbrowned, Northampton*

B.O.A.C., Canadian Pacific Airways, Australian National Airways, are all using Lincoln Ground Power Units for starting their new jet and turbo-jet airliners.

Lincoln Ground Power Units were responsible for all live starts of the de Havilland Comet and 110 Jet Fighters at the 1952 S.B.A.C. Farnborough Royal Air Display.

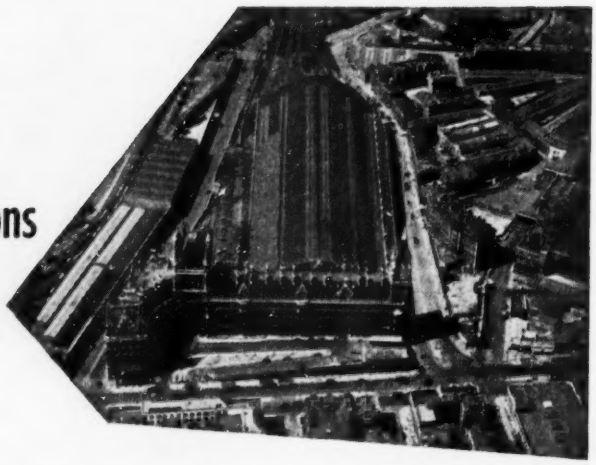
Production models and information on request.

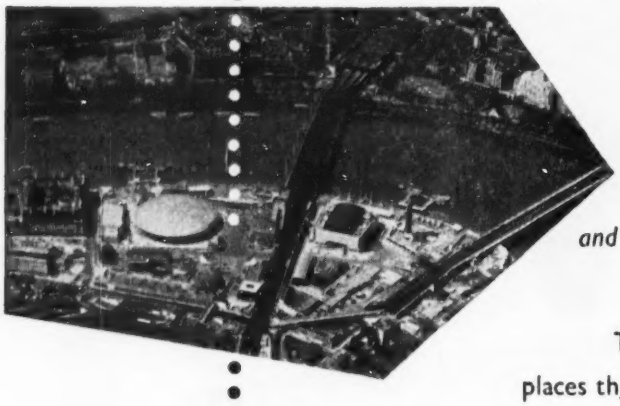
LINCOLN **Manufacturers of Ground Power Units for starting jet-propelled aircraft**

LINCOLN ELECTRIC CO LTD · WELWYN GARDEN CITY · HERTS · WELWYN GARDEN 920

GP 1

Whether Helicopters land on the top of London's Railway Stations





or on the South Bank site . . .

is not so important from the passengers' and crews' point of view... PROVIDED THAT: *THEY LAND ON PALMER BRAKED-WHEELS AND TYRES...*

The lightness of Palmer braked wheels and tyres places the least possible burden on the rotors consistent with the sure-footedness and strength that Helicopter constructors and PALMER know to be essential.

Palmer BRAKED-WHEELS & TYRES

PALMERS are the pioneers in this country of pontoons for Helicopters alighting on land or sea. To make quite certain that Palmer Pontoons are land-worthy they were subjected to a test in development that would make an Indian fakir look to his laurels. Fully inflated they were literally crashed down on iron spikes and came off unscathed.

THE PALMER TYRE LTD. · PENFOLD STREET · EDGWARE ROAD · LONDON · N·W·8

G.P.101

Castings for Comets

In the course of the last twelve months the Comet has fulfilled every promise. And while it has been proving itself in service, so have the *hundreds* of different light alloy castings that we supply for this outstanding aircraft.

The knowledge and experience that, together, have provided the answers to the casting problems of the Comet are available to you also. In this connection our Light Alloy Handbook will undoubtedly prove of interest. Please write for a copy.

Comet photograph reproduced by courtesy of The de Havilland Aircraft Co., Ltd.

J. STONE

AND COMPANY (CHARLTON) LIMITED, CHARLTON, LONDON, S.E.7

THE COMET

Now that the Comet has completed its first
year's service we are proud that we have contributed
a specially designed life-saving jacket
to its fine equipment.

air-sea rescue equipment

Makers of the inflatable Life Jackets for Passengers of Civilian Aircraft,
supplied to B.O.A.C., B.E.A. and other international airlines.
British Patent No. 647188, British Patent No. 673035.
Latest type inflatable Life Jackets for Service Aircrews and Airborne Forces.
Inflatable Exposure Suits, Naval Constant Wear Flying Immersion
Suits, Flying Overalls, Life-Saving Jackets and special
clothing for yachtsmen. Rubber Proofed Fabrics to D.T.D. Specifications.
A.I.D. and A.R.B. APPROVED

Head Office :

P. FRANKENSTEIN & SONS (MANCHESTER) LTD.

VICTORIA RUBBER WORKS, NEWTON HEATH, MANCHESTER 10

Telephone: FAILSWORTH 1166

PRODUCTION UNIT

BEAUFORT (AIR-SEA) EQUIPMENT LTD., BEAUFORT RD., BIRKENHEAD. *Tel. : BIRKENHEAD 731*

SH2

The S.E.P.2 takes over the COMET (Series 2)

Central Controller

The S.E.P.2 Automatic Pilot combines all the advantages of its famous predecessor, the S.E.P.1, with extra refinements to meet the exacting needs of modern high speed aircraft. S.E.P.2 has already proved itself under test conditions, and has been adopted for the De Havilland "Comet 2" and the Bristol "Britannia".

- *The S.E.P.2 has a height lock control, enabling the aircraft to be held automatically at a constant barometric height.*
- *An Automatic Approach Coupling is incorporated for linking the S.E.P.2 to the instrument landing system.*
- *The quick reaction of the S.E.P.2 circuit to flight deviations makes it suitable for modern fast airliners.*
- *The S.E.P.2 is 40 lbs. lighter than the S.E.P.1, representing a saving of weight of 25%.*

SMITHS

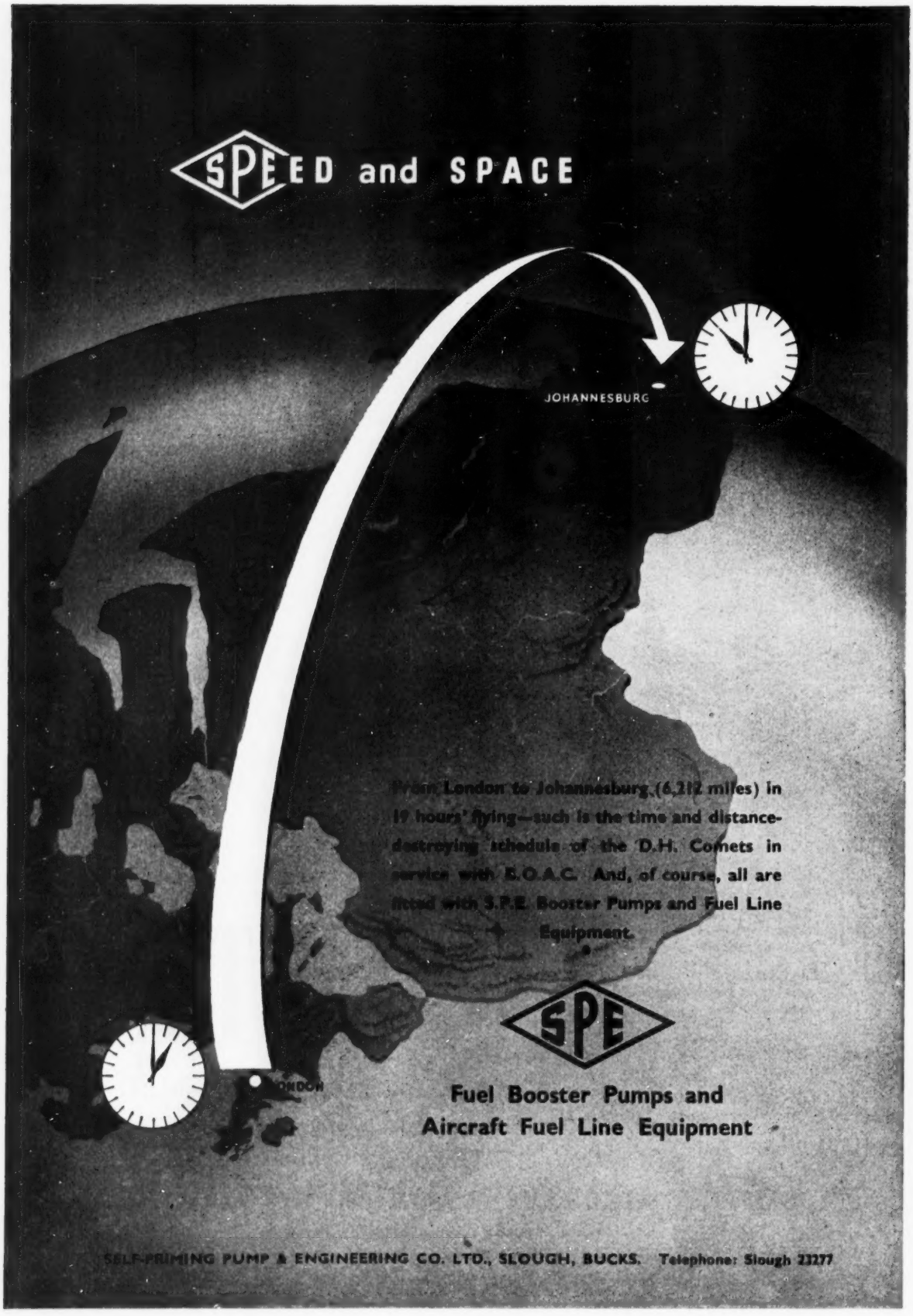
S.E.P.2 AUTO-PILOT

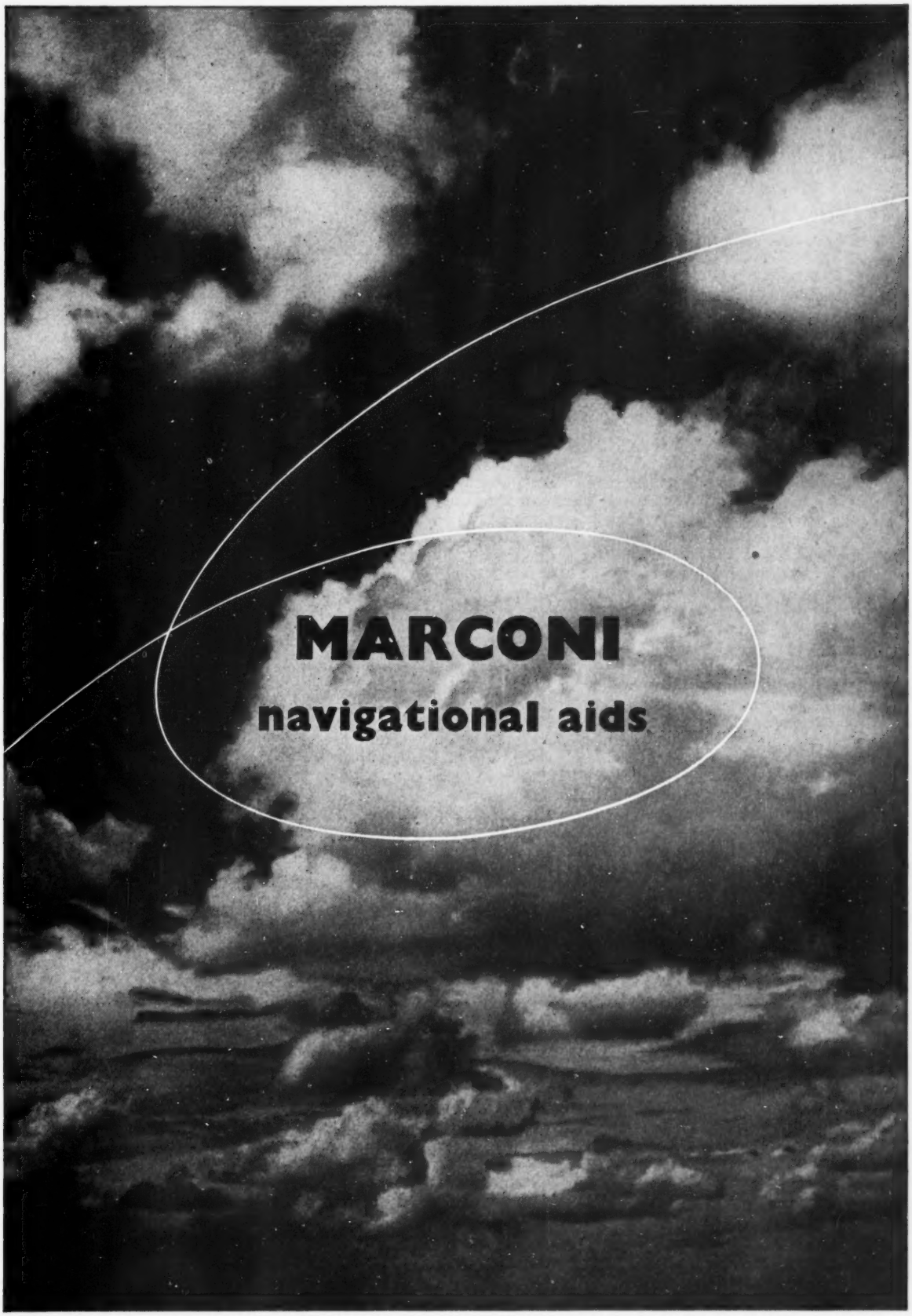
SMITHS AIRCRAFT INSTRUMENTS LIMITED

The Aviation Division of S. Smith & Sons (England) Limited

Cricklewood Works · London · NW2

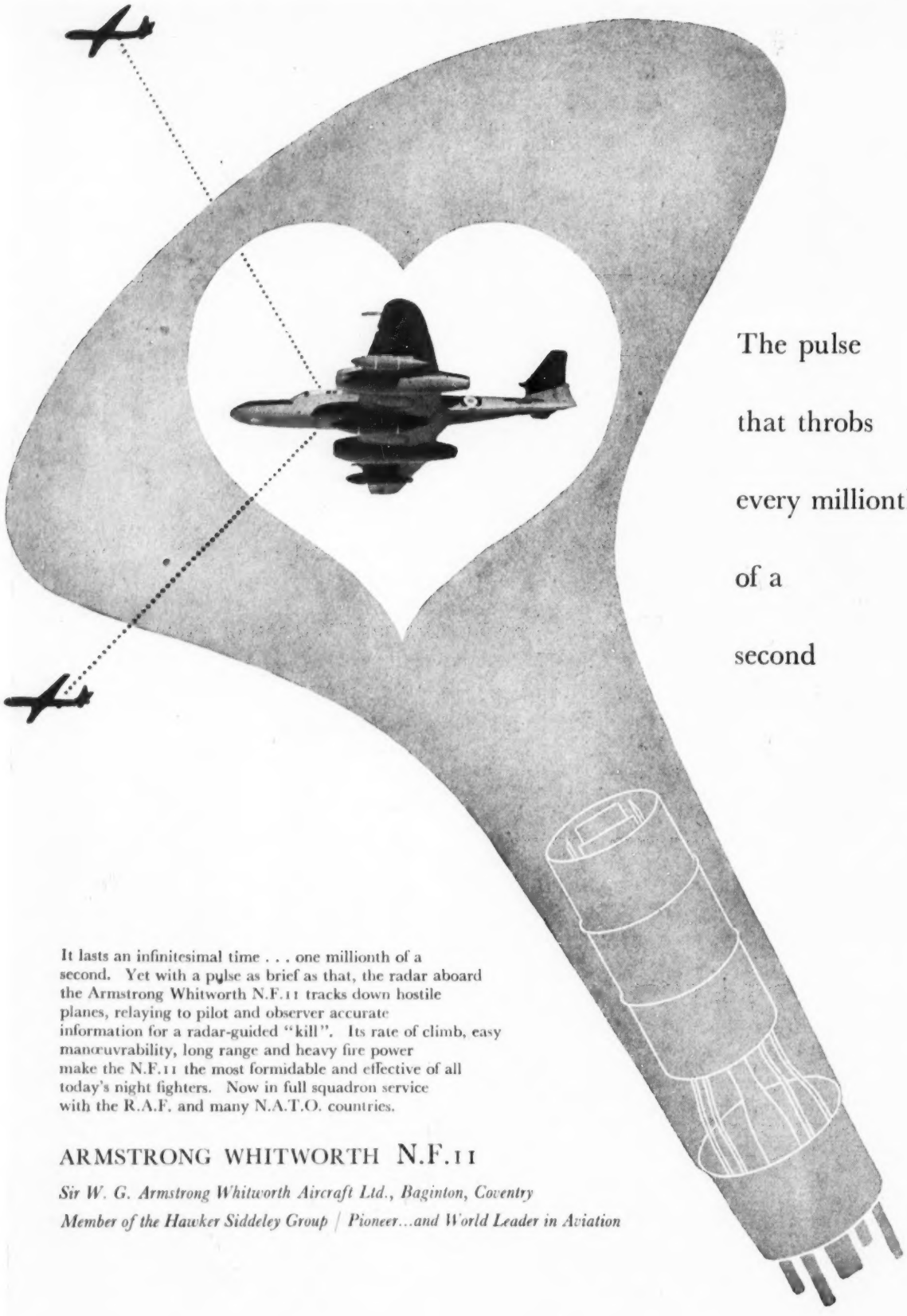
Sole Sales Concessionaires for Kelvin & Hughes (Aviation) Limited · Barkingside and Basingstoke


SPEED and SPACE
JOHANNESBURG
LONDON
From London to Johannesburg (6,212 miles) in 19 hours' flying—such is the time and distance-destroying schedule of the D.H. Comets in service with B.O.A.C. And, of course, all are fitted with S.P.E. Booster Pumps and Fuel Line Equipment.
SPE
Fuel Booster Pumps and
Aircraft Fuel Line Equipment
SELF-PRIMING PUMP & ENGINEERING CO. LTD., SLOUGH, BUCKS. Telephone: Slough 23277



MARCONI'S WIRELESS TELEGRAPH COMPANY LTD • CHELMSFORD • ESSEX

C



The pulse that throbs every millionth of a second

It lasts an infinitesimal time . . . one millionth of a second. Yet with a pulse as brief as that, the radar aboard the Armstrong Whitworth N.F.11 tracks down hostile planes, relaying to pilot and observer accurate information for a radar-guided "kill". Its rate of climb, easy manœuvrability, long range and heavy fire power make the N.F.11 the most formidable and effective of all today's night fighters. Now in full squadron service with the R.A.F. and many N.A.T.O. countries.

ARMSTRONG WHITWORTH N.F.11

Sir W. G. Armstrong Whitworth Aircraft Ltd., Baginton, Coventry

Member of the Hawker Siddeley Group | Pioneer...and World Leader in Aviation

FLIGHT
and
AIRCRAFT ENGINEER

First Aeronautical Weekly in the World

Founded 1909

No. 2310 Vol. LXIII. FRIDAY, 1 MAY 1953

EDITOR
MAURICE A. SMITH, D.F.C.

ASSISTANT EDITOR
H. F. KING, M.B.E.

ART EDITOR
JOHN YOXALL

Editorial, Advertising and Publishing Offices:

DORSET HOUSE,
STAMFORD STREET,
LONDON, S.E.1.

Telegrams, Flightpres, Sedist, London.
Telephone, Waterloo 3333 (60 lines).

Branch Offices:

COVENTRY
8-10, Corporation Street.
Telegrams, Autocar, Coventry.
Telephone, Coventry 5210.

BIRMINGHAM, 2
King Edward House,
New Street.
Telegrams, Autopress, Birmingham.
Telephone, Midland 7191 (7 lines).

MANCHESTER, 3
260 Deansgate.
Telegrams, Iliffe, Manchester.
Telephone, Blackfriars 4412 (3 lines).
Deansgate 3595 (2 lines).

GLASGOW, C.2.
26b Renfield Street.
Telegrams, Iliffe, Glasgow.
Telephone, Central 1265 (2 lines).

SUBSCRIPTION RATES
Home and Overseas: Twelve months £3 3s. 0d. U.S.A. and Canada, $10.00.
BY AIR: To Canada and U.S.A., six months, $16.

IN THIS ISSUE:

Aden Protectorate Support Flight 532
Conversion to Comets - 535
Education by Simulation 540
Comet Turn-round - - 541
Jet Airline Anniversary 545
Jet Air-routes - - - - 547
Comet Highway - - - 548
Comet Liveries - - - 550
Comet Engineering - - 551
Civil Jet Operations - 556
Assessment of Operating Costs 560

Unsure Foundation

CIVIL aviation in all its branches has great expectations of the present Government. It was with regret that *Flight* felt compelled to comment, earlier this year, that these hopes were not being realized—mainly as a result of omission rather than of obstruction. Now, fortunately, there are signs that some of the principal problems facing air commerce are at least being considered sympathetically, although little enough has actually happened—even with due allowance for the seemingly interminable time taken by high-level discussions. Still there remains this most debilitating atmosphere of transience; the feeling of no stability, a continued leaning towards temporary expedients in place of long-term planning.

We do not suggest that anyone thinks for a moment that British commercial aviation will not hold its own, or doubts that eventually (maybe sooner than some imagine) the Merchant Air Fleet will be playing a very important part in the life of almost every individual in the land. What we do believe is that civil aviation is not a thing that can be turned on and off, encouraged one day and set back another. More than any other it is an industry which, if it is to progress and be successful, must be the subject of long-term and courageous planning, of continuity of purpose and of stability and confidence. Where these pre-requisites are absent, the least of the ills which follow are inefficiency, unbalance and late timing. In such a highly competitive business as air commerce this amounts to missing the boat.

The development of civil operating companies and their opportunities to develop are, with the exception of the special cases of the Corporations, still unsatisfactory. In particular, it is a matter of national importance that conditions be created that will enable independent companies to order without delay new aircraft for a variety of duties, one of the most important of which is main-line freighting.

It is common knowledge that the Services in their planning are relying to an increasing extent upon merchant aircraft. A large and varied fleet is therefore in the country's interests in this connection also. In the right circumstances private money would be forthcoming to purchase new aircraft. It is not so much direct financial aid which is required from the Government as insurance and a guarantee of continuing normal business freedom. There are precedents for a degree of direct financial aid for such equipment, and certainly no individual or group can take lightly the placing of an order which for each aircraft may involve £$\frac{3}{4}$ million and three or more years of delay before delivery. Yet it is in the national interests that such orders be placed, and soon.

And who will crew the expanding merchant fleet and replace existing pilots as they retire? The source until now has been the R.A.F., but it is one that has virtually ceased; and the training of such surplus military pilots as there may be is no longer so suitable for commercial flying as it once was. Like the aircraft they fly, the provision of fully trained commercial airmen—for pilots must be much more than drivers—entails a long and costly production period.

Far from fostering improvements in the facilities whereby the ordinary young man may learn to fly, the Government's tactless and precipitous order to close R.A.F.V.R. units has done more to harm active civil flying and airmindedness in the country than has any other single action which we can recall. Accepting—and we do—the need to save some £2 million in a multi-million estimate, and agreeing also that the usefulness of V.R. pilots to the R.A.F. is fast passing, few unpleasant duties have been so ham-handled as the sudden, unheralded announcement of the end of V.R. flying schools.

It might be thought that haste would have been made to alleviate the hardship and dislocation caused; but our enquiries reveal only official indecision and the absence of information which is essential to the men who are trying so hard to keep the clubs and airfields in being. Those seeking guidance are transferred from Transport Ministry to Air Ministry and as quickly back again. Worse in its effect is the impression given to many members of the staffs of the civil airfields that the M.T.C.A. is not really interested in whether their airfields remain open or not. We have mentioned but a few of the rubs. What sort of foundation is this for the new Elizabethan air age?

FROM ALL QUARTERS

THE HUNTER ORDER and NATO FIGHTER PRODUCTION

FOLLOWING the signing of various contracts in Paris on Thursday of last week, and bearing in mind previous information, it is now possible to assess fairly accurately the extent to which each of various fighter aircraft have so far been ordered—some with, and some without, American financial backing—for the different NATO air forces. The extent of the orders to date may, therefore, be summarized as below. The size of the Hunter order is most impressive, exceeding as it does even the most optimistic of the forecasts which we quoted last week.

Great Britain.—*Hawker Hunter:* As is well known, a considerable contract for the re-equipment of the R.A.F. with Avon- and Sapphire-powered aircraft has been in existence for some time. Now a new offshore contract for no fewer than 450 Avon-powered machines has been awarded to Hawkers. Delivery of the aircraft concerned will begin in 1955 and be completed by June 1956, a year later than the original deadline; and the value of the order is $140m (£50m). The cost of one Avon- or Sapphire-powered Hunter therefore appears to be approximately £110,000—a figure which includes armament, radio, and essential spares. It is hoped that many of the aircraft will be allotted to the R.A.F., but the Americans naturally reserve the right to allocate them as they deem necessary, and final decisions have not yet been taken.

Supermarine Swift: Production of this aircraft is now in full swing. An original order was placed for the re-equipment of Fighter Command, and later a further number of aircraft were ordered as part of Britain's contribution to the general NATO plans, the machines concerned being also destined for Fighter Command. The value of the second order has been quoted as £25m, which, taking the price of a Swift as being approximately equal to that of a Hunter, represents about 250 aircraft.

Hawker Sea Hawk: An order of unspecified magnitude for the re-equipment of the Royal Navy was placed some time ago. Now a new $13m (£4.6m) offshore contract for more than 100 aircraft has been awarded—in this case, outside the general NATO programme. A rough calculation indicates that the approximate price of a R.-R. Nene-powered Sea Hawk is £40,000.

Belgium and Holland.—These countries are to manufacture Hunters and Avons under licence. The engines are to be made in Belgium, the airframes by both countries. The precise extent of airframe manufacture in each country has not yet been finally determined. Total orders are for £56½m, of which £15m ($42m) is an American offshore contract and the remainder a direct agreement between Great Britain and the Belgian and Dutch governments. All aircraft manufactured are destined for the re-equipment of the Air Forces of the two latter countries.

France.—Offshore orders for the Mystère IV (Hispano-built Tay, with afterburner) amount to $86½m (£31m) and, in addition, France has made her own contribution to the joint programme by setting aside a further $91m (£32½m) for production of Mystère IVs and IIs, the latter being equipped as ground-support aircraft.

Italy.—Non-materialization of anticipated Venom contracts left the Italian airframe industry faced with widespread unemployment, and, in order to offset this situation as quickly as possible, a contract has been awarded to Italy for the immediate assembly of F-86D Sabre all-weather fighters. Components are available in the U.S.A. for the Italians to assemble, and later they may construct units of the aircraft themselves if jigs are supplied by North American Aviation.

One aircraft not mentioned is the Javelin. It is now quite clear that no production of this type under this year's $550m (£200m) offshore programme is envisaged, but it is known that the Americans were very impressed by the performance of the machine during recent evaluation trials. It seems not unlikely, therefore, that something may be heard of Javelin production in a future dollar-backed scheme. Certainly the need for a transonic all-weather fighter for Europe's defence seems paramount. According to *The Times*, Belgium, Holland and Norway "have all agreed to buy a large number of all-weather fighters."

Short Bros.' New Test Pilot

FROM Short Brothers and Harland, Ltd., comes news of the appointment of Mr. E. A. Hyde as a test pilot. Mr. Hyde formerly served as a staff pilot of the Naval Ferry Flight operated by Short's Flying Schools Division. After service in the Royal Air Force, during which he flew many fighter sorties in Burma, he joined Airwork, Ltd., as a maintenance test pilot before taking up duties with the Naval Ferry Pool. A member of the R.Aux.A.F., he acted as Senior Flight Commander of No. 615 Squadron until his transfer to Belfast.

Mr. E. A. Hyde.

Garden Party Plans

THE Royal Aeronautical Society's annual garden party—to be held at Hatfield on Sunday, June 14th—will again have private flying as its principal *motif*, and this year—the fiftieth anniversary year of powered flight—there will be a strong historical flavour.

The famous aircraft on view are to include the Bristol Bulldog and the Gloster E.28/39, both from the Science Museum, and there will be a replica of the original Wright engine.

Other historical types, more familiar at displays, will include the 1910 Deperdussin, 1912 Blackburn monoplane, Sopwith Pup, Bristol Fighter, Avro 504K and Hawker Cygnet. Bert Hinkler's little tractor-pusher Ibis, recently discovered near Southampton, will make its re-appearance.

Moving through the twenties and thirties, also, there will be a Blackburn Bluebird, D.H. Puss Moth, Hawker Hart, Gloster Gladiator, Miles Hawk Speed Six, Hawker Hurricane and Vickers-Supermarine Spitfire. Post-war types will include the Miles Aries, Prestwick Pioneer and Sweden's Saab Safir. Flying demonstrations of all the newer and (weather permitting) some of the earlier aircraft will be given.

Striking a more militant and spectacular note there will be—if present plans mature—a Meteor aerobatic squadron and the French Stampe squadron.

This year's event will be a true garden party, for the guests are to be accommodated on the lawn of Astwick Manor, the D.H. Technical School's H.Q. on the edge of the airfield. The Central Band of the R.A.F. will provide music.

Tickets are obtainable only through R.Ae.S. members.

A Symposium on Noise

THE names of lecturers at the all-day symposium to be held in London by the Royal Aeronautical Society on Thursday, May 21st, are now announced. The meeting, held jointly with the Acoustics Group of the Physical Society, will take place at the Institution of Mechanical Engineers. The subject is "Aeronautical Acoustics—in Particular, Jet Noise," and the papers will be as follows:—

From 10 a.m. to 11.30 a.m., *Engine Noise*, papers by Prof. E. J. Richards, F.R.Ae.S., and F. B. Greatrex, A.F.R.Ae.S.; 11.30 a.m.-1 p.m., *Aircraft Noise*, papers by G. M. Lilley, A.F.R.Ae.S. (*Aerodynamic Noise*) and C. H. E. Warren (*Noise Associated with Supersonic Flight*); 2.30 p.m.-4 p.m., *Ground Noise*, papers by N. Fleming (*Air-to-ground Noise*) and J. D. Hayhurst, A.F.R.Ae.S. (*Ground-to-Ground Noise*). A general discussion will follow, until 6 p.m.

The Size of Infrastructure

FURTHER details are available of the vast scope of the "Infrastructure" programme which has now been authorized by the Atlantic Council. By the end of 1956, 124 airfields are to be constructed in the NATO countries, and 34 more in Germany. Twenty-eight of the latter are already usable, and 80 of the former are scheduled to be completed before the end of this year. The total cost of the programme, which also includes such installations as headquarters, radar stations and naval bases, will cost £685m—of which £250m constitutes the additional amount authorized by the latest session of the Council last week.

A notable feature of "Infrastructure" is the provision of an underground pipeline system to supply the airfields with jet-aircraft fuel. Two thousand miles or more of pipe will be required. Such a scheme may sound extravagant, but in fact promises to be extremely economical in terms of surface transport saved, owing to the inordinate amount of fuel that would be required in a "shooting" war. Furthermore, a road and rail transport can readily be dislocated by bombing, whereas it is relatively difficult to inflict serious damage on a pipeline system from the air.

THIS ISSUE OF "FLIGHT"

TODAY, May 1st, marks the completion of a year's successful operation of British gas-turbine airliners in scheduled service. As a tribute to the splendid pioneering work of the aircraft constructor and airline organization concerned—de Havilland and B.O.A.C.—the major part of this issue of "Flight" is devoted to important articles on the achievements, results and lessons learned.

New Night Fighters

RECENTLY announced are the D.H. Venom NF.3 and the Gloster/Armstrong Whitworth Meteor NF.13. Both aircraft are superficially different from earlier marks; the Venom NF.3, for example, will have a frameless canopy, new combat equipment and large dorsal fins.

Incitement to Desertion

LAST Monday Gen. Mark Clark's headquarters in Tokyo made an offer of £17,850 cash, plus resettlement in a non-Communist country, to any aircrew deserting from North Korea with a modern Russian-designed fighter. The offer was contained in leaflets and broadcasts in Russian, Chinese and North Korean.

Flying the X-3

A DRAMATIC account of "Bill" Bridgeman's first flight in the Douglas X-3 supersonic research aircraft on October 20th last year is given in the current Atlantic edition of *Time*.

A variety of troubles, the precise nature of which is not stated, appear to have occurred on the first flight—including "acting up" on the part of the turbojets. When recalled, Bridgman remarked to Chuck Yeager, who was "flying chase" in an F-86, "This thing doesn't want to stay in the air." He touched down at well over 200 m.p.h. It was Yeager who virtually guided Bridgman in for his landing, for view from the X-3's cockpit is practically nil. "It's a nasty little beast," Bridgman is quoted as remarking, "and the Skyrocket was a queen."

Large parts of the X-3's skin—especially those which receive heat from the turbojets as well as from skin friction—are made of titanium.

Maj. C. J. Stewart.

Mr. F. H. Carey.

Dowty Fuel System Appointments

TWO appointments to the Board of Dowty Fuel Systems, Ltd., Cheltenham, were announced last week—those of Maj. C. J Stewart, C.B., O.B.E., F.R.Ae.S., M.I.M.E., and Mr. F. H. Carey.

Maj. Charles John Stewart was educated at the Royal College of Science. His first appointment was that of Patent Office Examiner, Board of Trade, and in 1913 he became H.M. Inspector of Engineering Education. In the 1914-18 war he served with the Royal Engineers, the R.F.C. and the R.A.F. until 1919, when he became head of Instrument Research, Air Ministry.

From 1931 to 1938, Maj. Stewart was Superintendent of the R.A.E., Farnborough. In 1939 he joined the Air Ministry as Director of Civil Research and Production. He was appointed to the Ministry of Aircraft Production in 1940 as Director of Production, and became Deputy Controller of Production in 1942, serving in this capacity until 1945, when he entered business as a consulting engineer. For many years he has been a technical adviser on fuel systems to Dowty Equipment Ltd.

Mr. Frederick Henry Carey has been connected with the industry since 1925, when he began his apprenticeship with the Bristol Aeroplane Co. Ltd. On leaving that company in 1933, he was with Armstrong Whitworth, then, from 1935 until 1938, he specialized in the design of hydraulic pumps and controls at the Lockheed Hydraulic Brake Co., Ltd., and Bendix Ltd. In 1938 he joined Parnall Aircraft, Ltd.

In 1944 he took up an appointment with the Dowty organization as designer of fuel systems.

A HASTINGS THROUGH THE IRON CURTAIN

MUCH has appeared in the newspapers about the homecoming of the seven civilian internees from Korea, but so far few details have been learned of the journey of the Transport Command Hastings which collected them from Moscow. Now the full story is told, vividly, by an Air Ministry officer.

He starts by recalling that when the Hastings, WJ.338, set out from Lyneham shortly before 0600 hr on Monday, April 20th, with destination Moscow, the object of the flight was known only in vague terms. At Moscow the aircraft was to take on as passengers Capt. Vyvyan Holt, the former British Minister in Seoul, and six others. The state of health of the passengers was not known and as a precaution the Hastings was equipped to take stretcher cases, together with a R.A.F. medical officer and nursing sister. Aboard the aircraft were: Captain, F/L. P. E. Pullan; 2nd pilot, F/L. P. I. Badley; navigator, F/L. E. T. Orringe, D.F.C.; signaller, Sgt. J. N. Fulker; flight engineer, Sgt. J. W. Leeming; air quartermaster, F/Sgt. R. E. Houston; fitters, F/Sgt. D. L. Bourke, Sgt. R. S. Tooke; medical officer, W/C. E. B. Harvey; nursing sister, Flt/O. J. S. Weir.

The flight to Templehof airport in the U.S. sector of Berlin was uneventful. S/L. F. A. Drury, D.F.C., station commander of Gatow, met the aircraft and, some two hours before the departure for Moscow was due, S/L. F. Poulter, A.F.C., from the quadripartite Air Safety Centre, Berlin, arrived at the operations room. With him was a R.A.F. interpreter and two of his Russian colleagues from the Air Safety Centre—a major and a senior lieutenant of the Russian Air Force—and a Russian navigator and wireless operator, belonging to Aeroflot, the Soviet air-transport organization. The R.A.F. crew had already obtained clearance from the U.S.A.F. operations officer and they turned to the anticipated briefing for the flight itself. The procedure in fact, amounted more to a briefing of the Russians by the R.A.F. crew, who came away with a list of names of towns on the route and the weather forecast for the route—and little else. The Russians required a fairly limited range of information, all essential to their needs, and the time taken in their "briefing" arose more from translation difficulties than anything else.

The R.A.F. use of knots took a great deal of explaining; but after a time, provided the term nautical miles per hour was employed by the interpreter, the Russians had little difficulty in making the necessary slide-rule conversions. The Russians then

(*Concluded on page 564*)

WELCOME HOME: First British aircraft to visit Moscow for a long time was the Hastings of Transport Command which brought home seven civilians freed from Korean internment. Capt. Vyvyan Holt, formerly British Minister in Seoul, is seen leaving the aircraft at Abingdon. Meanwhile, arrangements had been completed in the East for another Hastings to fly home the first 22 wounded ex-p.o.w.s from Iwakuni.

Faithful Annie finds romance at Beihan, on the Yemen border.

Aden Protectorate Support Flight

A GLIMPSE OF A "PRESS-ON" LITTLE R.A.F. UNIT

"Flight" Photographs

THIS cameo of Air Force life is one of a hoard of experiences and anecdotes brought back by the Assistant Editor from a 32,000-mile tour of Middle East, Far East and Korea. The first article in the series, describing the return trip, via the Cocos Islands and Mauritius, appeared in the issue of March 27th. Others are projected for the near future and will culminate with a major contribution to our special Coronation number, "The Queen's Air Forces," to appear on May 29th.

WHEN W/C. C. R. A. Forsyth, D.S.O., Station Commander at Khormaksar, Aden, invited us to divert our attention from a Vampire fighter/bomber squadron to a flight of Ansons and Austers, he did not electrify us with excitement. True, our curiosity was aroused when he named it as the Aden Protectorate Support Flight, for both protection and support have a certain "operational" tang. But Ansons and Austers after Vampires . . . Bath-chairs after B.R.M.

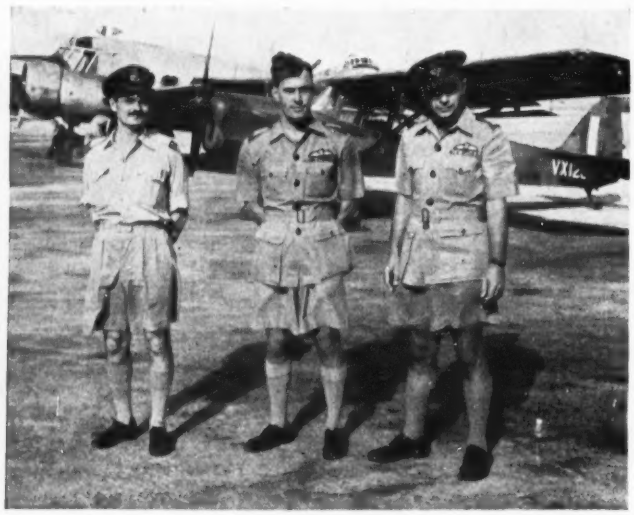
The Flight's commanding officer, F/L. I. T. Chambers, D.F.C., hardly struck us as being ripe for retirement; and when he explained the function of his unit—flying political officers up-country, supporting the Aden Protectorate Levies when they were in the field and propitiating Arab dignitaries—we decided that here at least was something different.

Throughout the Protectorate, he said, were numerous strips—available, according to size and altitude, to Austers, Ansons and Valettas. At Beihan, on the Yemen border, for instance, where there had formerly been a strip of 700 yd, a new one of 1,500 yd had just been completed and had already been tested by a Valetta. It was a picturesque specimen, and one that we might well see for ourselves.

We did so.

Our pilot was F/O. Mudry, who contributed to the expedition a sardonic humour, a few maps ("as a gesture"), and a fund of local lore. It was afternoon. The met. was fraught by a threatening haze, and a return to Khormaksar before evening was imperative. So we bundled ourselves straightway aboard Anson 19 VP524, which churned out to the runway and there pulled up—with a certain petulance, we thought—to give way to an Air-India Constellation.

Officer Commanding the A.P.S.F. is F/L. I. T. Chambers, D.F.C. (centre). Left is F/L. Miller, and right F/O. Mudry, who flew the author to Beihan.



When Annie and Connie were through with their Gert and Daisy routine we headed out over the desert in what F/O. Mudry solemnly assured us was industrial haze. Later we heard it described as an uplifted dust storm; but whatever the true nature of the phenomenon, the flying officer shrugged his shoulders and continued the climb.

After a while we perceived brown hill tops, and by the time 10,000ft was showing on the clock, a ghastly nightmare of crouching mountains was below. We shared the pilot's satisfaction in finding that a certain unmistakable *wadi* was plainly featured on his "token" map.

We had been airborne over an hour before cartographical and natural signs jointly proclaimed the imminence of the strip and the flying officer (quite reasonably, we thought) put the stick forward. But though this certainly effected a change in attitude, it did not, in any appreciable degree, affect the altitude. Another shrug, another push, and there ensued a spirited drama of the desert air, enacted between the daring R.A.F. officer on the one hand and the bold, bad Arabian up-draughts on the other—with the favours of Manchester Annie as the prize. The R.A.F., of course, emerged victorious in the end, and Annie was soon being conducted through the mountains towards the strip.

Suddenly we were in a sort of lost world. The mountains brushed past the windscreen as we hauled round into wind, and we made an immediate mental award of the A.F.C. to the pilot who had brought in the first Valetta. All at once we were down and, having collected our nerves, wits and sunglasses, we emerged into the fierce heat of this sand-floored mountain bowl—3,600ft above sea-level, within easy rifle-shot of the Yemen border.

We gazed upon the near-black, ragged, happy, dirty children; the Government Guards, glued to their rifles; the camels—hobbled, or slow-padding on their way; the gay blades with one or two gambias apiece tucked in their loin-cloths; the palms; and the dried-mud buildings—grand and mean.

Into one of the largest and handsomest of the houses we were bidden by Rais Umbarak, in charge of the local Govern-

ment Guard post, and he interpreted a welcome from the well-to-do owner, Mohamed Awat. We squatted briefly on a Beihan rug in one of the clean and airy rooms, nibbling raisins from a cloth placed by our side, and scanned a painted frieze, such as one might see in a child's nursery. Brightly coloured, it depicted in elementary style such commonplace objects as a rifle, dagger and camel—and a twin-engined monoplane. It seemed, in fact, that aircraft were inescapable, and when we learned that an Englishman, in the sparsely-clad person of Mr. Hugh Cuthbert, of Desert Locust Control, was "in town," we sought him out—only to have him introduce himself as an ex-sergeant, Wimpey IIs.

Our return take-off was too protracted, and the bumps above the cooling sand far too hearty, for comfort. Undying affection notwithstanding (for we flew in the prototype 18 years ago), we reflected that the Anson was no longer the aeroplane she was—especially for work over such country as we now had to traverse again. She will not—and it is hardly surprising—hold 10,000ft on one engine, and only with difficulty have pilots of the Flight pulled off three base-landings after engine failures.

We happened to ask F/O. Mudry which was the smallest strip from which the Flight had operated, and he supposed it to be Dhala, on the Amiri Plateau in the Western Aden Protectorate. He recalled having been there with F/L. Chambers; but not until later (and from a third party) did we hear the full story.

It all began when F/L. P. H. Mason, commanding a detachment of Aden Protectorate Levies encamped near the 5,000ft-high Auster strip decided to go out monkey hunting. Seeing a movement, a fitter in his party fired. The shot pierced Mason's heart and wounded his orderly in the arm.

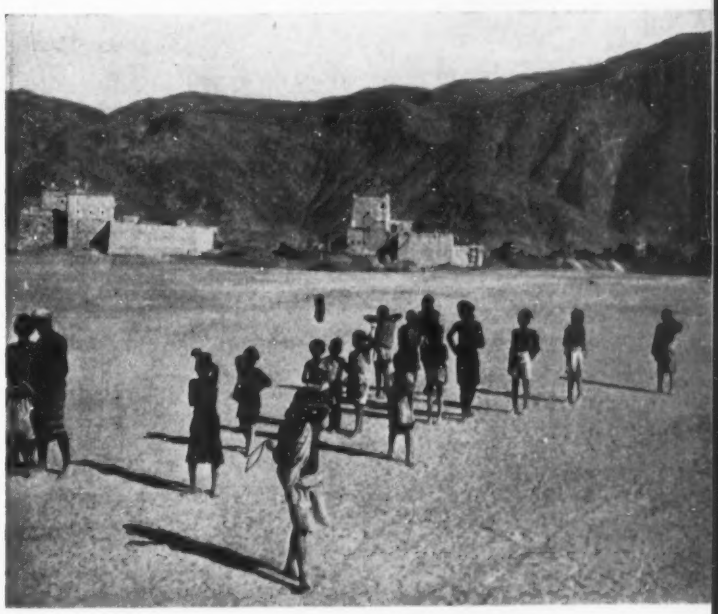
The orderly, having made his way back to camp, an Arab R/T. officer flashed a signal to Levy Headquarters at Aden, whereupon a Land Rover and a three-tonner were hastily loaded up—the first with a Levy doctor, surgical kit and blood plasma, and the three-tonner with an escort of Levy soldiers. They set out across roadless, mountainous, rutted, boulder-strewn country on a 95-mile trip rarely accomplished in under 8 hr. The Levy drivers made it in 4 hr 20 min.

After a blood transfusion Mason slept; but the doctor had decided that it would be dangerous to operate, and signalled Aden accordingly. Immediately the Support Flight was alerted, and two Ansons, with F/L. Chambers and F/O. Mudry as pilots, took aboard a surgeon, an anæsthetist, an operating-theatre sister, a corporal theatre-assistant, complete equipment for a major operation, and a supply of fresh blood. They put down safely on the Auster strip.

The surgeon again decided against operating on the spot; so, after another transfusion, Mason was placed aboard an Anson, which somehow clambered into the air after a down-hill run, and flew back to Aden. There, 160 volunteer blood donors had answered an emergency call, and a pint each had been contributed by 22 of Mason's group. The hole in his heart was found to be large enough to take a man's finger; in fact, the squadron leader surgeon actually sewed the heart around his own finger before drawing the stitches together.

"Mason, P. H., F/L.," still figures in the *Air Force List*.

H. F. K.



Dried-mud buildings at Beihan and (below) juvenile reception committee seen as the Anson draws up on the sun-drenched airstrip.

NAVIGATION AT SOUTH KENSINGTON

AN exhibition with the title "Navigation Today" was opened at the Science Museum, South Kensington, on April 22nd by Lord Waverley, P.C., G.C.B., G.C.S.I., G.C.I.E., F.R.S., chairman of the Port of London Authority. Lord Waverley was introduced by Air Chief Marshal Sir Frederick Bowhill, G.B.E., K.C.B., C.M.G., D.S.O., Chief Aeronautical Adviser to the Ministry of Civil Aviation. A vote of thanks to Lord Waverley was proposed by Vice-Admiral A. Day, C.B., C.B.E., D.S.O., president of the Institute of Navigation and Hydrographer of the Navy; it was seconded by Dr. F. Sherwood Taylor, M.A., Director of the Science Museum.

The instructive if not altogether comprehensive display has a marine rather than an aeronautical bias: the problems of the air navigator could, perhaps, be more amply presented, and some exhibits would do well with fuller explanatory notes. Nevertheless, there is material of topical interest. A well-executed mock-up of the navigator's panel and pilot's station in a de Havilland Comet is to be seen; also on show—possibly outside strictly navigational bounds—is a G.E.C. combined high- and low-intensity runway light not yet installed in the United Kingdom.

Perhaps the most instructive display in the exhibition is that showing the Decca Navigator Company's equipment, including the well-known Flight Log and the earlier Flight Plotter: these exhibits are presented with admirable clarity. Also to be seen are composite met. forecast charts for air survey work, and an interesting exhibit showing the prevailing winds, and the variability of winds in January, over the British Isles at heights of from 10 to 50,000ft.

Quite a number of aircraft navigational instruments are on show, including an air-mileage unit, radio altimeter, magnetic and Gyrosyn compasses and gyropilot. Marconi have a model of a complete Consol station, and diagrams and working models explaining G.C.A. radio ranges, V.O.R., and Gee can be studied.

The exhibition, as we mentioned last week (p. 506) in connection with a series of lectures to be given during its course, will remain open until September 20th.

HERE AND THERE

National Air Race Entries

THE entry-list for the National Air Races (Southend-on-Sea, June 20th) closes on Monday next, May 4th. Entries, accompanied by the fee of £10 for each race (except the King's Cup) should be sent to the Secretary-General, Royal Aero Club, 119 Piccadilly, London, W.1.

Veteran for Olympia

A BLERIOT monoplane from the Shuttleworth collection at Old Warden, Bedfordshire, is being loaned for the R.A.F. main event at the Royal Tournament at Earls Court during Coronation month. It will represent the pre-1914 era in a pageant of progress in Service aviation.

First Air Race of 1953

ALTHOUGH entries for the Wolverhampton Aero Club's Goodyear Trophy Race (Municipal Airport, Wolverhampton, May 16th) closed yesterday, April 30th, late entries sent immediately to the hon. secretary will be considered. The race begins at 3 p.m. and will be preceded at 2 p.m. by a flying display, for which there will be R.A.F. and Naval support; the Stampe squadron will also participate. Visiting aircraft must arrive by 1.30 p.m., and buffet lunches will be available for their crews. Admission for the public is at 2s 6d (children, 1s 6d).

The Unknown Load-Factor?

TO celebrate the 30th anniversay of its foundation, Sabena, the Belgian Airline, is organizing an annual contest with the purpose of recognizing each year the work of an outstandingly good artist, and of enabling him to widen his scope by travelling to such countries as the United States and the Belgian Congo. The 1953 prize (of just under £700 value) will be awarded—to a sculptor, under 40, resident in the United Kingdom or in one of the other 30 countries served by Sabena—for a work suitable for placing in the company's new air terminal in the centre of Brussels. Further details are obtainable from Sabena's London headquarters, at Terminal House, Grosvenor Gardens, S.W.1.

STRATOBOOMERS: High over the American Middle West this Boeing B-47B (solid nose and underwing 1,780-gal tanks) makes a delightful study as she takes on fuel from a KC-97F of the same make. The tanker has the Boeing-developed "flying boom," extended and guided from the Ryan-built rear-fuselage. One B-47 recently made 69 such contacts during a 1,000-hour programme; but the U.S.A.F. have now adopted the British Flight Refuelling probe-and-drogue method.

N.Z. Race Withdrawal

THE American Aircraft Corporation, of New Jersey, has advised the Royal Aero Club of the withdrawal of the entry of their Spitfire 24 from the New Zealand Race. It was to have been piloted by the company's president, Mr. Peter Freytag, who lost his life while flying it on April 17th.

Old Faithful

A SECOND batch of four Mustangs (seen below) was recently delivered to the Israeli Air Force; purchased from the Swedish Air Force, they were ferried across Europe from Bromma by Swedish pilots. Incidentally, the last F-51 Mustang in Korea recently retired from active service, but America still has some in service with Reserve and National Guard units. Altogether, North American Aviation turned out 15,367 Mustangs, of nine different marks.

EX-SWEDISH MUSTANGS for the Israeli Air Force (see "Old Faithful", above). The photograph was taken at Nicosia, Cyprus, during the delivery-flight.

S.B.A.C. Public Admission

WE understand that the S.B.A.C. Display at Farnborough will again this year be open to the general public on the final three days, that is, Friday to Sunday, September 11th-13th. Friday will be the day of the "public première."

SOUVENIR: This special airmail stamp, in red, has been printed in America to mark the fiftieth anniversary, this year, of the Wright brothers' flight. The U.S. Post Office has announced that it will be on sale on May 29th.

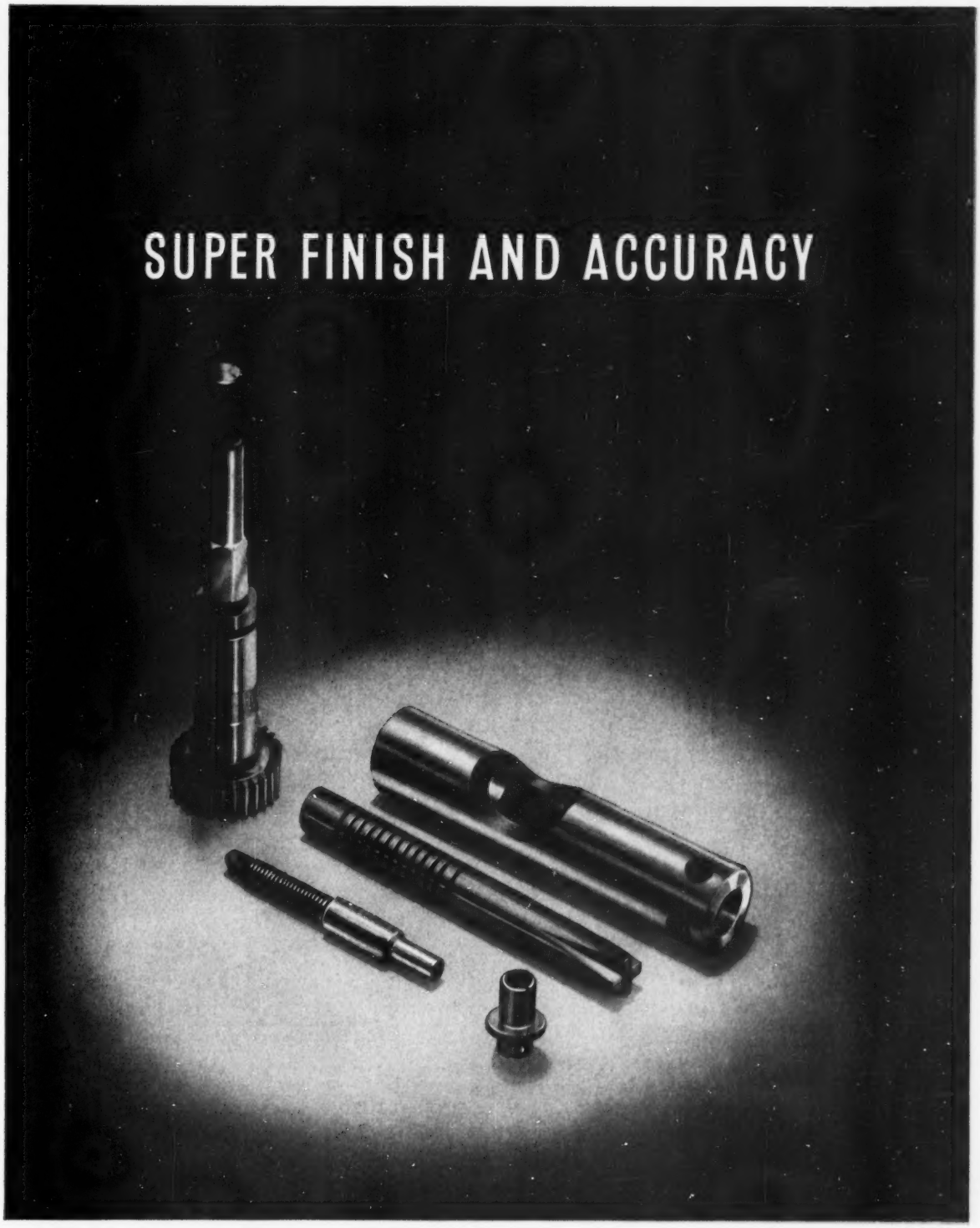
Good Reading for Motorists

ALL who are interested in cars and their uses are reminded that next Friday's (May 8th) issue of our associated journal *The Autocar* will be the special Coronation (and "British Cars for the World") Number. It will include numerous noteworthy articles and a four-page colour feature.

Charles Gardner Joins Vickers

WELL KNOWN for his good work as the B.B.C. Air Correspondent, Mr. Charles Gardner is to join Vickers-Armstrongs, Ltd., at the end of this summer, as assistant to Mr. George Edwards, chief designer and general manager of the company's aircraft division. In addition to his radio and TV activities (which are not expected to cease completely when he leaves the B.B.C.), Mr. Gardner is also a journalist and an experienced pilot.

SUPER FINISH AND ACCURACY



No 1. Fuel flow controlled by components of high surface finish and accuracy within twenty-millionths of an inch.

Fuel and Combustion Systems for Gas Turbine Engines

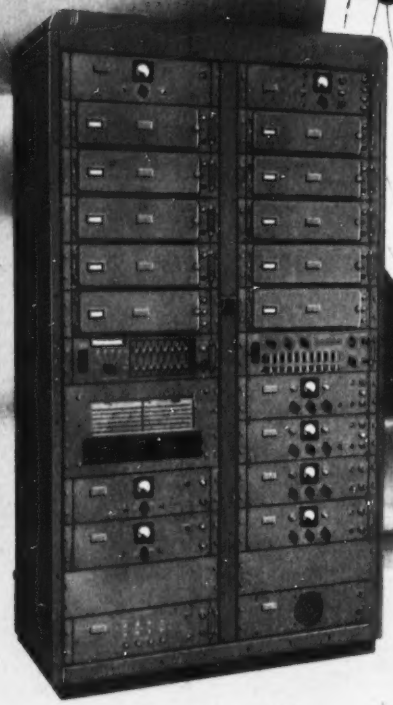
LUCAS

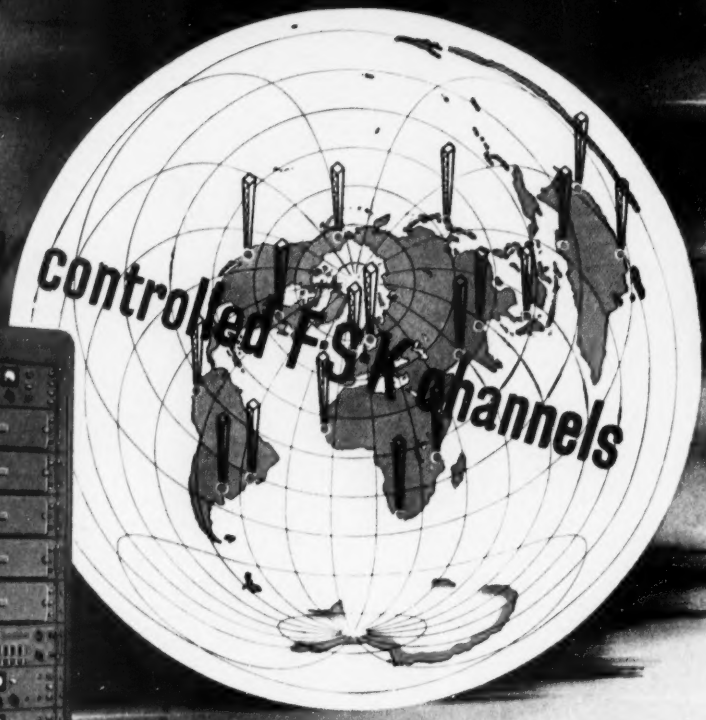
JOSEPH LUCAS (Gas Turbine Equipment) LTD., BIRMINGHAM & BURNLEY

D

Plessey produce the first compact RTT link for unattended operation

4 remotely controlled F.S.K. channels in one equipment





A product of the Plessey group of companies working in collaboration with International Aeradio Limited.
Descriptive literature of the complete system or of similar equipment providing more or fewer channels, is available from either organisation.

THE P.V.R. 80 RADIO TELE-TYPEWRITER RECEIVING TERMINAL
Designed as an adaptable multi-channel equipment for the faultless reception of F.S.K. signals with extreme stability, even under the most severe propagation conditions. Automatic channel changing without signal interruption: Remote control effective up to 10 miles: Individual units available separately for incorporation in existing systems: The Receiving Terminal and its associated Transmitter equipment fulfil I.C.A.O. requirements.

INTERNATIONAL AERADIO LIMITED · 40 PARK STREET · LONDON · W1
THE PLESSEY COMPANY LIMITED · ILFORD · ESSEX

CONVERSION to COMETS

A Transport Pilot on Flying the World's First Jet Airliner

*Captain's panel (l. to r. from top): A.S.I. (knots), gyro-horizon, I.L.S. indicator, Mach meter, altimeter, Zero Reader, gyro compass, A.D.F. indicator, turn-and-slip indicator, clock, rate-of-climb indicator and Zero Reader control. Central engine panel—four of each: r.p.m. indicators, j.p.t. gauges, dual oil-temperature and fuel-pressure gauges, rear-bearing temperature and pressure gauges and, behind throttles, fuel-pump switches. The second pilot's flight instruments almost duplicate those of the captain.**

THE post-war re-equipment of B.O.A.C.'s fleet may well be taken as a measure of the progress made since 1945 in developing new commercial aircraft. Superficially, the graduation from converted bombers to the world's most advanced airliners means no more than a reduction in the passenger's journey-time and an improved standard of comfort en route. To the pilot, the changes are obviously of far deeper significance. This notable article, discussing the Comet from the pilot's viewpoint, reflects the impact of the "jet age" upon the theory and practice of operation evolved with piston-engined airliners. The author, a B.O.A.C. first officer employed on the South African and Eastern routes, has recently completed the series of technical and flying courses which comprise the standard conversion to the de Havilland Comet 1.

TO the many things written in the past few years about the Comet may now perhaps be added the views of a pilot who has made the jump from "steam aeroplanes" to a more advanced mode of travel. In this connection, the writer makes no bones about his preference for jet travel—and pure jet at that.

The first stage in Comet-conversion training is a seven-week course at the de Havilland Servicing School (later courses are being conducted at the B.O.A.C. Central Training Unit, Cranford). Enthusiasm compensates for the ignorance of jet flying which the new class of captains, first officers and engineers feel as they report to Hatfield to learn how the Comet is put together. Such items as power-boosted controls, bogie undercarriages, air brakes and so forth may be familiar to U.S.A.F. and R.A.F. pilots, but are quite new to most civil airline pilots—at least, when all these things are fitted to the same aircraft.

The D.H. course is most thorough and conforms to the usual high standard of technical training which B.O.A.C. insist upon for crew conversion to a new type. The seven weeks are split into periods for studying the Ghost 50 engine, the airframe (including hydraulic systems, of which there are four), electrics, pressurization, and a host of other important subjects—emergency procedures, aircraft flying limitations, loading, instrumentation, etc. Several visits are made to the Comet production-line in the factory nearby. I found that the invaluable help of actually seeing in the afternoon what had been discussed in the morning was a major contribution to a keen knowledge of the aircraft as a whole.

When individualists such as airline pilots gather together it is most natural that heated discussion will take place. In this case, the design of the Comet was an obvious topic for conversation, and it would be idle to pretend that there was no criticism. Where ancillaries are concerned, a pilot is liable to specify that bits and pieces of various aircraft that had served him well and faultlessly should be embodied in a new type. He may well ask why trouble-free electrical, hydraulic or pressurization systems which have been proved in everyday use cannot be applied in essence to all aircraft of a similar category. In short, where are the S.B.A.C. standards? Naturally, American aircraft come into the picture—and here I must say that in my view there has been, until recently, an undoubted superiority in American ancillary design—helped, no doubt, by the vast amount of capital utilized in research, and the very large quantity of aircraft manufactured in any one year.

It is quite evident that a considerable amount of thought has been expended to get the Comet ancillaries into the top line. Experience is telling the crews just how good the design is, but if one particular course had its way there would be a hybrid Comet/Canacruiser at present under development!

The end of the stay at Hatfield comes all too soon—and so, too, the Air Registration Board examination necessary in order to gain the licence endorsement enabling a pilot or engineer to operate as a crew-member on passenger-carrying services. This examination lasts one complete day, and contains about a hundred questions. Once this is successfully completed all one has to do is to complete the flying requirements as laid down by legislation. The B.O.A.C. course includes four 1½-hour periods of circuits and landings—two at night, two by day, and an instrument-flying period "on airways." A familiarization flight is made to demonstrate the onset of compressibility effects, to practise the emergency descent with air-brakes, and to demonstrate relighting an engine in the air.

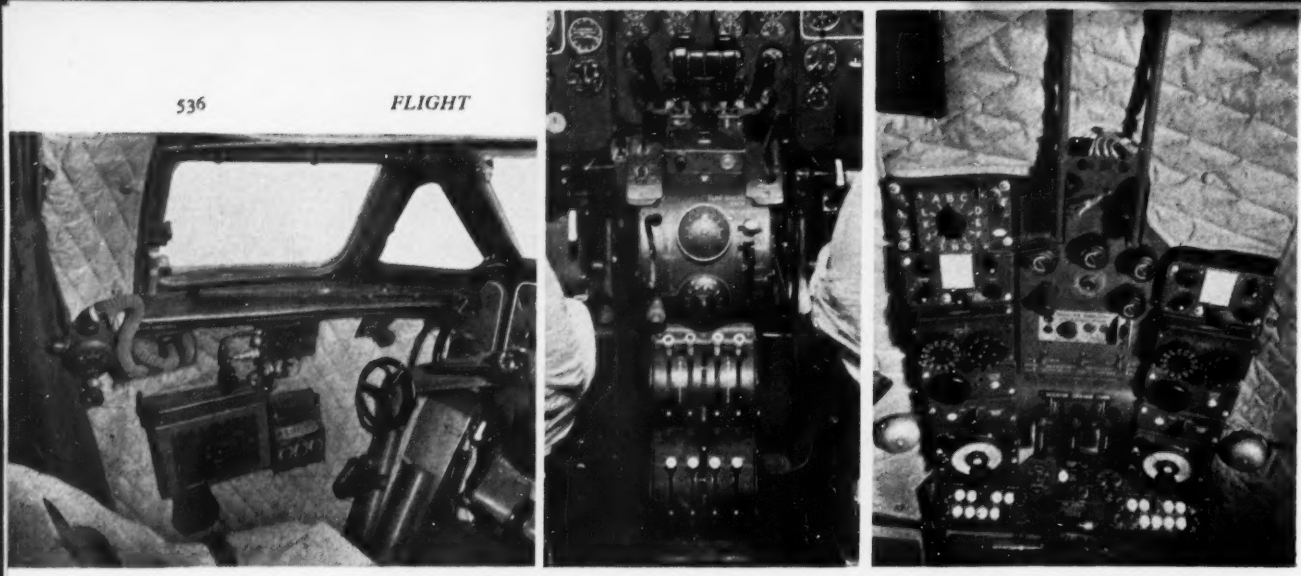
Let us study the sequence of a routine training flight from London Airport. The aircraft is standing outside the new alloy hangar which houses B.O.A.C.'s Comet fleet. Even on the ground it gives an impression of sleek thoroughbred beauty, a refreshing sight by comparison with many of the less graceful airscrew-driven airliners. Climbing aboard through the crew entrance, on the starboard side of the nose, one has to duck a little to enter beneath the sliding door, which latches in the roof.

The engineer carries out a comprehensive external check-list, checking fuel contents by the dripsticks, inspecting general conditions of all surfaces, wheels, cowlings, dinghy-covers, brake-leads, etc., and removing the three ground locking pins in the undercarriage. He then undertakes an equally thorough internal check of emergency exits, safety equipment (third dinghy, when carried, life jackets and portable oxygen), the baggage bay beneath the cabin floor and the equipment bay which lies below the galley and forward cabin. These two bays are accessible in flight, as are the Servodynes which actuate the flying controls.

On the flight deck, the captain begins the "Before starting engines" check from a list read by the first officer. Flying controls are verified on the yellow (emergency) hydraulic system, and cockpit controls are set for starting. The Smiths S.E.P. 1 autopilot is tried for operation in all three axes and the "limit cut-out" switches are also tested to ensure availability of positive disengagement should any of the flying control surfaces be moved outside narrow limits (this safeguard in the autopilot ensures that faulty operation cannot put the aircraft in a dangerous attitude). The first officer also checks the functioning of all warning lights, the hooter which signifies loss of hydraulic pressure in the "normal" flying-control system, the engine-fire warning bells and the smoke detectors in the fuselage bays. Tank-isolator cocks are placed "on" for all wing tanks and the cross-feed is checked off. At this stage the first officer contacts air-traffic control on one of the two independent V.H.F. sets and requests clearance to start up. This is the first important departure from normal piston-engine practice; it is due to the very high fuel penalty of idling gas turbines on the ground, total fuel consumption at idling speed (3,000 r.p.m.) being about 30 kg (some eight gallons) a minute.

When clearance is given the "Starting engines check" is begun.

* *Although this article is concerned primarily with B.O.A.C crew-training, the illustrations of crew stations are of the C.P.A. Comet 1A, the series of pictures being the latest taken and of particularly good quality. The main instrument and control layouts are practically identical with those of B.O.A.C. Comets, and the radio and navigational equipment differ to only a small extent.*



(Left) The captain's switch panel is for landing lights, cabin signs, intercom control, audible Mach meter, engine-starter master-switch and (below) screen wiper—off, slow, fast. Beside it is the Ultra radio station-box; the other items are the pilot's oxygen supply and intercom plug. Note the nosewheel steering control on the main control column. On the central pedestal are mounted (top, l. to r.) brake, throttle levers and flap lever, just below which is the air-brake lever. At the base of these are the autopilot controls and, below again, the undercarriage selector lever, flap indicator and trimmers and their indicators (the elevator wheels are on each side) and, below again, the four H.P. cocks and the four main fuel-cocks. (Right) The controls in the roof are mainly concerned with radio but include also landing-wheel and door indicators, controls for emergency systems, lighting rheostats and alarm bells.

CONVERSION to COMETS . . .

Throttles are closed, isolation switches set to "normal" and, the ground engineer being warned, and with starter master-switch "on," and low- and high-pressure cocks "on," the start is commenced.

Either No. 1 or No. 4 engine is started first; with the selector set for the appropriate engine, the single starter-button is depressed to initiate the 30 sec starting cycle. The button is held in by an electrical relay until the cycle is complete. If the ground power supply, normally taken from a 28 V generating truck, is not sufficient, the button may have to be pressed until the relay is energized by alternator output from the starting engine. It is now standard practice, incidentally, to start with the alternator switched on; it will then provide power as soon as the engine in question reaches sufficient r.p.m.

If the starting cycle is interrupted by removal of ground power or failure of the relay, the probable result is a "hot start" with excessive jet-pipe temperature (maximum is 725 deg C)—and the only safe thing to do is to put the high-pressure cock off and allow drainage before a re-start. The engine may be motored with the fuel off in order to clear the gases. When all four engines are idling at 3,000 r.p.m., the starting procedure is completed by a check of flying-control operation on the "blue" (normal) hydraulic system, and the ground electrical supply is removed. All alternators are checked for correct operation, voltage and load-sharing. Engine instruments are checked for correct temperatures and pressures, and there is a final check that a.c. failure lights and door warning-lights are out, followed by the Zero Reader check and alignment of the C.L.2 compass.

Radio equipment, including the twin auto direction-finders and the I.L.S. and marker receivers, are tested and tuned for take-off procedures. Possible settings would be No. 1 A.D.F. on Dunsfold, No. 2 on Epsom radio-range, and the I.L.S. selected to the correct stud for Runway 10-Right at London. The aircraft is ready to taxi as soon as A.T.C. have given taxi clearance; the control officers offer the maximum co-operation and normally there is very little delay.

With chocks away and parking-brake off, the outboard engines are opened up to about 6,000 r.p.m., the inners remaining at 3,000 r.p.m. to conserve fuel. After a few seconds' delay, while the necessary thrust develops, the Comet begins to move. The "outers" are then throttled to a setting—say 4,500 r.p.m.—sufficient to keep a moderately high taxi speed. Light and effective steering is provided by a wheel, of the self-centring type, on the captain's control column. Flying-control surfaces are locked hydraulically until the actual trim or main controls are operated from the cockpit, so there is no "snatch" in the rudders as, for instance, in the DC-3, which needs the second pilot or the autopilot to hold the rudder pedals central during taxying in a high wind. Brakes are of the toe-operated type so well pioneered by many American aircraft during the war; the Dunlop disc-and-pressure-block system gives adequate braking under all conditions with which the writer has yet had to deal. Development is proceeding on the application of the Maxaret type of braking to the later, heavier marks of Comet.

Should the hydraulic nosewheel steering fail, the nosewheel castors, and differential brake-action will effectively steer the aircraft. The toe pedals simultaneously operate two separate brake systems, providing another safeguard. Lacking the piston aircraft's airscrew-drag (and in some cases reverse-thrust), and being of such clean aerodynamic shape, the Comet shows an inclination to "keep right on to the end," so brakes are a major item, and must be 100 per cent reliable. Stand-by pressure for brakes and nosewheel steering is provided by the operation of an electrical pump, which is left on for taxying and take-off.

During the roll to the take-off position the "before take-off" check is completed. Flying instruments are examined for serviceability, and the "blue" pressure-failure warning-horn is switched on. Flying controls are checked finally on the "blue" system; pressures should be normal. Flaps are set to 15 deg and aileron, elevator and rudder trims at take-off setting, air-brakes "off" and pitot heaters on.

Critical speed (V1) and unstick speed (V2) are then read out for the runway in use. These speeds are obtained from the operations manual, which contains charts showing regulated take-off weight, V1 and V2 for individual runways at all airfields used by Comets for every condition of wind, temperature, pressure-altitude and runway slope. These values are finalized from the last available data transmitted on V.H.F. R/T. from the control tower.

At the maximum permissible a.u.w. of 105,000 lb (47,627 kg)* the critical speed at London Airport on the E.W. runway is 95 kt I.A.S. and the unstick speed 100 kt I.A.S. Under calm conditions the 3,000 yd available allow maximum weight to be used. At many airfields on the Eastern and South African routes a runway gradient factor must also be taken into account. High ambient temperatures also penalize the jet engine and, combined with high altitude, do in fact restrict the take-off weight at such hot airfields as Entebbe (3,772 ft) and Livingstone (3,230 ft).

When all instruments have been checked, the engine fuel-pump isolation solenoids are switched to "isolate" and back to "normal," their operation being checked by a rise and fall in r.p.m. Pressurization controls, fuel-tank booster-pumps, fuel feed, thermal deicing, emergency hydraulic selector, alternator, instrument (26V) and main (115V) inverters, fuel flowmeter, fuel-contents gauges and cabin air conditioning—all these will have been set correctly by the engineer as called out from the check-list by the first officer.

If possible, A.T.C. will have given clearance on to the runway while the Comet has been taxying. This avoids both the noise and the fuel-penalty of using high power to get the aircraft rolling once more.

With the nosewheel central and engines throttled, the parking brake is applied. If take-off clearance has been granted, the throttles are opened slowly until the jet-pipe temperature gauges reach 500 deg C; the levers may then be moved progressively forward (recommended time from idling to full opening is 10 sec).

When the four Ghosts are running at 10,200 r.p.m. the isolation switches are switched to "isolate," and the r.p.m. should rise to 10,250. The first officer and engineer carry out a swift but thorough final inspection of all engine instruments. Maximum figures

**Now certificated at 107,000 lb (48,535 kg)—Ed.*

The equipment at the navigator's station varies according to the operator's requirements, but this picture is representative. A.D.F. bearing indicator, master receiver controller, Gyrosyn compass master indicator, and intercom station-box can be identified on the main panel. Below them is seen the V.S.C. unit and on the left the oxygen supply, with Rebecca above it.

allowed are : engine r.p.m., 10,250; jet-pipe temperature, 725 deg C; oil temperature, 85 deg C; rear-bearing temperature, 160 deg C. If all fuel flowmeters are showing correct flow commensurate with maximum engine r.p.m., then the parking brake is released and the lever moved forward and off, effecting a smooth getaway. At this point, with fuel consumption at its peak, delay must be cut to a minimum.

The Comet soon begins to accelerate down the runway, giving a healthy "kick in the back" almost from the beginning of the take-off run. Nosewheel steering is used up to a speed of 60 kt, when the rudder is found to be effective. The standard technique for taking-off large tricycle aircraft is used; the captain has his left hand on the steering and his right on the throttles, then moves his right to the wheel; the first officer checks that the throttles are fully open. At 60 kt indicated he places both hands on the wheel and at 80 kt backward pressure on the wheel overcomes the only "feel" characteristic—that of a 40 lb spring strut—and raises the nose. This artificial feel is not representative of control loads imposed, and it behoves the pilot to be cautious in avoiding large control movements and the consequent danger of overstressing at high speed.

When the nosewheel rumble ceases a check forward is made on the elevators in order to stabilize the attitude of the aircraft. The nosewheels should be just off the ground, an attitude giving maximum acceleration. Depending on the weight, the aircraft will be ready to leave the ground at around 108-115 kt I.A.S. when a steady backward pressure on the control column will ease her off. Distance-run varies, of course, with conditions and weight, but during training in England at maximum landing weight of 75,000 lb (34,019 kg) the run is around the 1,500 yd mark. Naturally, the distance decreases as fuel is burned off at the rate of approximately 1,323 lb (600 kg) per circuit and landing.

Once the Comet is airborne it accelerates rapidly and continuously. The undercarriage is raised by the first officer, and speed is allowed to increase to 150 kt. The flap setting of 15 deg gives greatest angle of climb, and, consequently, maximum obstacle-clearance. Fuel-pump isolation switches are moved to "normal" at 100ft and when the climb-away is satisfactory the r.p.m. are reduced to 9,750, which setting is used throughout the climb to altitude. Flaps are normally raised at between 500 and 1,000ft and speed is allowed to build up to the correct cruising-climb figure (260 kt I.A.S., less 2 kt per 1,000ft a.m.s.l.). In practice, the captain aims to arrive at this correct figure by 5,000ft, maintaining a higher rate of climb and lower I.A.S. during the first part of the climb in order to reduce time spent at lower levels.

Cruising procedure with the Comet has already been the subject of several excellent articles, but a brief outline may not be out of place here.

Normal cruising procedure is to fly at constant incidence, decreasing the indicated air-speed as the fuel is burned off; the true air-speed increases slowly as weight is reduced. The usual incidence is that which gives the value of 1.3 times minimum-drag speed, but for purposes of weather avoidance the $1.15V_{md}$ cruise may be used; this is also of value when altitude decrease is necessary for other reasons (e.g., when on three engines). This is the sole flexibility in the cruise procedure, and the fuel reserves carried at present are large enough to cope with one pass at the destination airfield plus climb-out, cruise and descent to one designated alternative airfield, plus a variable holding and residual-fuel figure at that alternative.

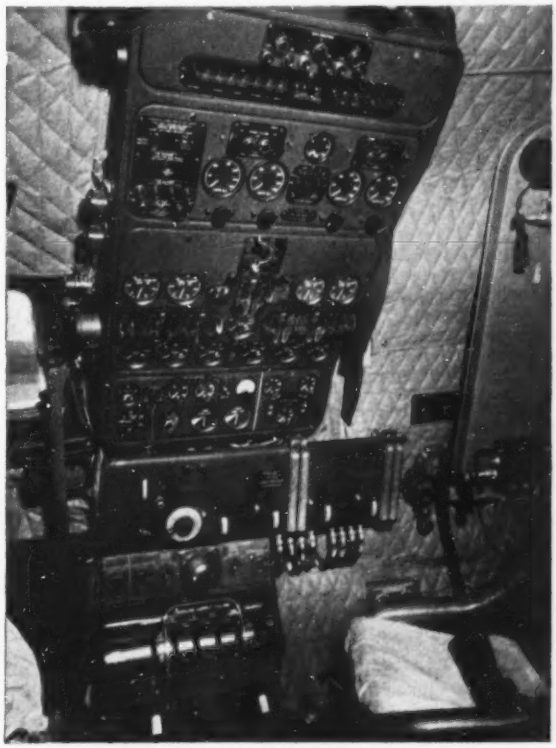
The three-engined case is not as critical as was at one time thought, thanks to the utilization of the technique whereby the aircraft is "drifted-down" to a new three-engined stabilization altitude. The correct $1.15V_{md}$ airspeed for the Comet's weight at time of engine failure (as shown in the operating tables) will produce the optimum rate of "drift down"; on reaching the new height (at, of course, a lower weight, due to use of fuel on descent), the aircraft will begin to climb along the three-engined cruising path as further weight is burned off. Thus, it will be apparent that, given the incidence to fly, be it $1.3V_{md}$ or $1.15V_{md}$, the Comet is at all times operated at the maximum altitude, and will climb at a constant 30-40ft/min throughout the cruise period.

In training, it is usually the practice to give a pilot a complete 1½ hr period during which a climb to a height of 35,000-40,000ft is made. The time taken varies with weight but is around 40 minutes, with initial rate of climb of 2,000ft/min, coming down to 500ft/min in the later stages.

After take-off the feet are removed from the rudder pedals, and not replaced until the approach at destination; this is to avoid overstressing the rudder at high speeds (as would occur if extremely coarse movements were made) and to give greater passenger comfort. Control for turns is quite adequate on ailerons alone, and above 20,000ft the recommended rate of turn is 1½ deg/sec, or 360 deg in four minutes. This is necessary to limit the angle of bank, which is approximately 29 deg for a rate-half turn at 400 kt T.A.S., and also to limit the *g* applied at high T.A.S.

A new factor is the inaccuracy of electrically-driven artificial horizons at high altitudes. If the aircraft is levelled out after a sustained turn by reference to a visual horizon, the artificial horizon is seen to be showing a turn in the opposite direction. This can be highly disconcerting to the senses, but reference to the needle-and-ball turn-and-bank instrument soon gives reassurance. The latter, being a "rate" instrument, does not suffer from this error, which is caused by the usual tendency of the artificial horizon to erect with horizon-bar parallel to the wings; on the Comet this effect is accentuated by the large bank-angles and slow rate of turn at high T.A.S.

Referred to as the engineer's panel, although the Comet crew does not necessarily include a flight engineer as such: The top dials and switches are concerned with the electrical system of the aircraft; the second panel is for the Ghosts' fuel system; below it again are the controls and indicators for the cabin pressurization and conditioning system; the levers at the bottom are for fuel cross feed, de-icing and cabin supply-valves.



CONVERSION to COMETS . . .

The Comet is of such clean design that rapid acceleration is possible if the nose is lowered but a few degrees from the level-flight attitude. Mach number at the end of a cruise in the colder temperate latitudes may be as high as 0.74; thus, with a limiting Mach number of 0.77 and an I.A.S. of 300 kt (whichever is reached first), it can be appreciated that a careful watch should be kept on the fore-and-aft attitude.

The feel-less hydraulically actuated controls provide no indication of loads applied, although departure from a trimmed position of the control column is achieved only after overcoming the spring strut which biases each set of control cables on the input side of the hydraulic Servodynes. Should the column be released at some position away from the trimmed point it will return to that position smartly. This can be unpleasant, and the pilot must guide the column firmly and steadily back to the trimmed position.

There is lag of the air-speed indicator to represent small changes of pitch by increase/decrease of I.A.S., and acceleration/deceleration might be progressing before any indication showed on this instrument. The artificial horizon is not large enough in its presentation to allow detection of such small changes, but the Sperry Zero Reader does provide a magnified indication of pitch, and is very useful. The most reliable method is by reference to the vertical-speed indicator, which provides almost dead-beat indication of change of pitch.

Pressurization is controlled by the engineer, who maintains the flow of air tapped from the engine compressors at constant level in order to avoid surges. He must also watch for malfunctioning of the automatic equipment, checking the cabin differential pressure up to a maximum of 8.25 lb/sq in (8,000ft cabin altitude at 40,000ft). Any change in r.p.m. calls for rapid manipulation of the mass-flow valves, which the automatic equipment does not always cope with. The engineer must also record and integrate fuel-flow readings to give a constant check of weight and fuel on board.

At about 10,000ft on a normal passenger flight, the first officer moves back to the navigation table, where he continues to work until the descent. On a training flight, however, the instructor/captain occupies the right-hand position, and local navigation is carried out by radio from the pilots' seats.

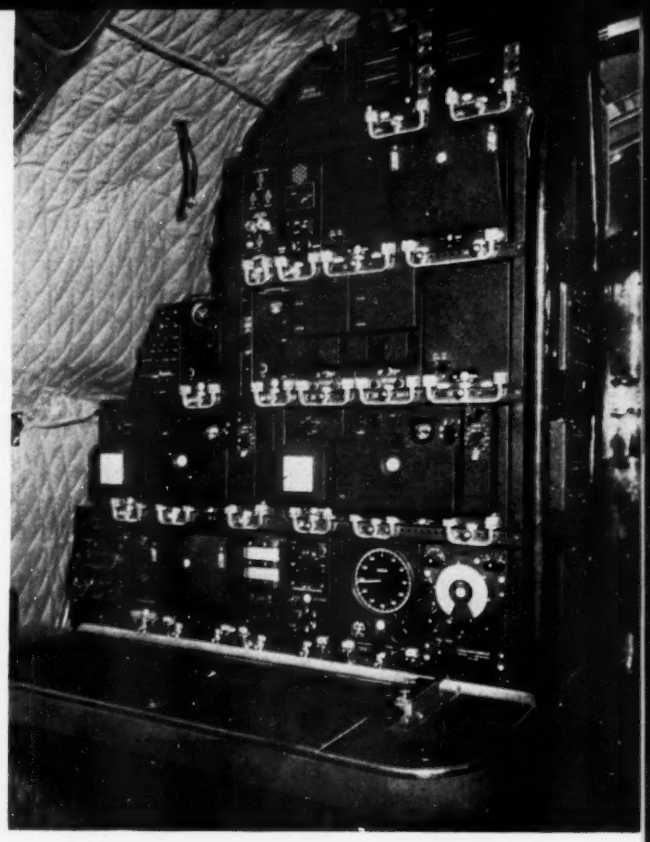
Although an emergency check-list is carried, the usual practice fire-drills are demonstrated and must be learned correctly. The engine fire-drill is as follows: (1) Fully close throttle of engine concerned; (2) turn off H.P. cock; (3) operate first shot of methyl-bromide extinguisher bottle; (4) turn off L.P. cock; (5) alternator off; (6) turn cabin-pressurization air shut-off valve to "spill"; (7) de-icing valve off. If the fire-warning relights, begin an emergency descent and discharge second shot from extinguisher.

Turns on limited panel are carried out, together with orientation on a radio range and a homing to the station. Climbing on constant Mach number is also practised. On reaching the desired altitude the aircraft is levelled out for a high-speed run at 9,750 r.p.m. With the nose slightly down to build up speed, Mach number is increased to 0.76 and load trimmed out of the control column. Extra forward pressure on the column results in an increasing Mach number. Initially, the Comet will tend to lift her nose back to the trimmed position, but as speed increases to about M=0.78 this nose-up tendency disappears, and a continued inclination for the nose to drop illustrates the onset of compressibility, with consequent change in the airflow characteristics over the wing.

This procedure allows a demonstration maximum Mach number of 0.81 to be attained, but maximum indicated air-speed is kept below the 300 kt limit throughout. Mach number decreases as the nose is raised; at about M=0.79 the stick load is reduced as trim once again takes effect. At M=0.77 the air-brakes are extended, producing a slight nose-up tendency, sharp deceleration and the gentle buffeting which is characteristic of these very necessary items.

The next demonstration is an emergency descent. Throttles are slowly closed, and the nose is lowered until the A.S.I. shows 300 kt. The resultant rate of descent is around 9,000ft/min; attitude is quite remarkable, and the pilot seems to be looking straight down the nose at the earth. The fact that he can direct the aircraft towards a landmark only slightly ahead of the nose illustrates the effectiveness of the air-brakes, which allow a rapid descent to a flight-level where oxygen is available and where life can be sustained without pressurization.

In order to avoid unrepresentative Mach number effects, an altitude of about 15,000ft is chosen for the stalling demonstration. With undercarriage and flaps up and throttles closed, the nose is held up to decrease the I.A.S. until the severe pre-stall buffeting sets in. No transmission of the buffet is possible through the irreversible flying controls, but the airframe shakes. Due to the force of this buffeting, it is not usual to allow the aircraft to stall in this configuration. The warning signs begin at 10 kt before the stall, which, with the aircraft "clean," occurs at indicated speeds of 98 kt and 115 kt at weights of 75,000 lb and 105,000 lb respectively. With wheels down and 15 deg flap selected, similar buffeting is encountered before the stall takes place. With flap-settings of 40 deg or 60 deg (and power on or off), any stall-warning is hidden by the normal slight buffet present under these conditions, but the warning is less severe and either wing can be picked up before it drops more than 20 deg from the horizontal. Indicated stalling speeds at 75,000 lb with full flap are approximately 90 kt (power on) and 96 kt (power off); with power on, the nose drops suddenly. In most cases the height lost should not exceed 500ft.



The radio equipment is practically the same for all Comets. The lower rack contains intercom station-box, D.F. switch box, communication receiver units, bearing indicator, and loop controller and master receiver controller. Above are high-frequency amplifier and drive units, A.D.F. receiver units, and others for power supply, intercom power, glide-path, localizer and marker.

An illustration of the Comet's excellent asymmetric performance is the stall with two Ghosts on one side throttled and the other two at 9,750 r.p.m. Full rudder control is maintained right down to the stall.

Use of air-brakes with flap already selected is permissible up to 40 deg flap; a strongish nose-up tendency results when air-brakes are lowered with 15 deg flap on. Without flap there is little trim-change on selection of air-brakes. The exercise is usually completed with a demonstration of a flapless landing, which entails a very flat approach and a long float before touch-down, as well as a tendency to overrun, wheel brakes being the only decelerating force available. The technique of handling the Comet at low levels around an airfield is largely similar to that practised with most large piston-engined aircraft. Speeds are not out of the ordinary: down-wind, 150 kt with 15 deg flap; cross-wind, 135 kt with wheels down and 40 deg flap; final turn, 125 kt. The approach-path is stabilized with engines at 7,000-8,000 r.p.m. (the lower limit of 7,000 ensures a swift increase in thrust should an overshoot be required), and adjustments of 500 r.p.m. keep the aircraft on the correct glide-path.

Lowering of full flap (60 deg) alters the flight-path considerably, and to avoid application of further power at this stage it is usual to try to overshoot slightly, so that full flap brings the aircraft down on to the correct glide-path. For this reason, coupled with the lag between r.p.m. change and alteration of glide angle, the normal practice is to select full flap early in the approach—at least before 500 ft.

In short, the circuit-and-approach procedure calls for intelligent anticipation and good judgment; but the effect of the well-known lag in power-response characteristic of jet aircraft is by no means as critical as might be expected.

Final stages of the approach are carried out at 110-115 kt. The runway threshold is crossed at 100-105 kt, the conventional tail-

TI and the Comet

T.I. Aluminium have been privileged to supply Aluminium Alloy Tubing, Bar and Extrusions for the De Havilland Comet Jet Air Liner. In particular, we pride ourselves on the successful production of the Wing Stringer Sections. These were required in DTD 363 with a maximum thickness on the flanges of .05" and .07" thick on the channel portion. Weight control was particularly important, and a further requirement was that both flanges should be dead flat and parallel to each other. The successful solution of the production problems involved is another instance of teamwork behind the scenes which enables T.I. Aluminium to maintain a high standard of service to the Aircraft Industry.

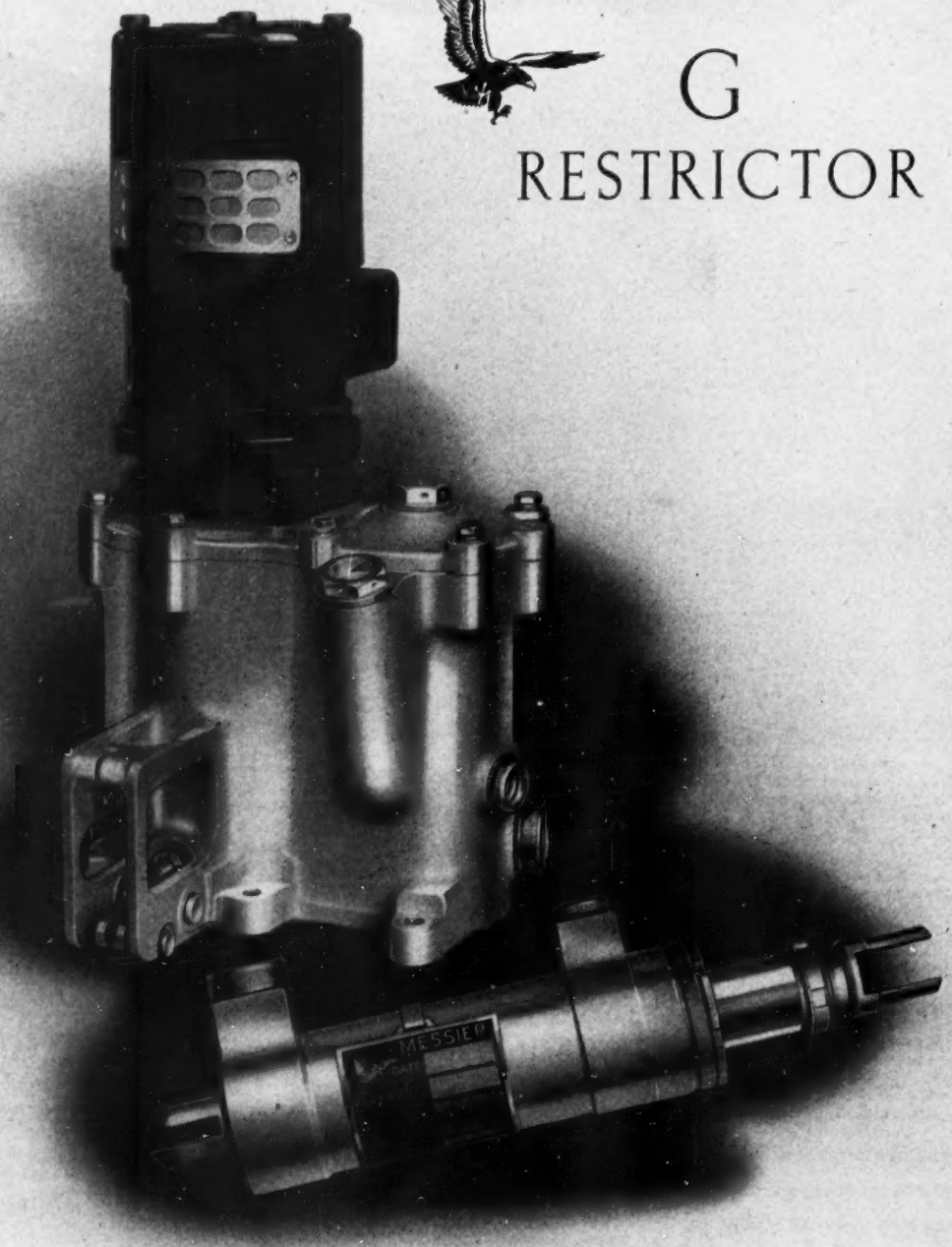
PUT Aluminium FIRST
AND TI IN FRONT OF IT

T.I. ALUMINIUM LTD
REDFERN ROAD, TYSELEY, BIRMINGHAM. TEL: ACOCKS GREEN 3333
ALUMINIUM AND ALUMINIUM ALLOY INGOT, SLABS, BILLETS, SHEET, STRIP, TUBES AND EXTRUSIONS TO ALL COMMERCIAL, A.I.D. AND LLOYD'S SPECIFICATIONS.

A TI COMPANY

BRITISH MESSIER

G RESTRICTOR



A "G" Restrictor applicable to aircraft elevator controls has been developed by British Messier for the Ministry of Supply and has been satisfactorily flight tested.

BRITISH MESSIER LTD · GLOUCESTER

B/BM 003

CONVERSION to COMETS . . .

down hold-off being adopted. Once again, however, no feel is available to help the pilot and, because of the shortness of the nose, the attitude cannot be judged as easily as in some aircraft. The rumble of the mainwheel bogies indicates touch-down and the nosewheels are lowered on to the runway at about 70 kt (this prevents their dropping-on as the nose nods forward when flying speed is lost). If the cross-wind component is low, deceleration can be improved by keeping the nose well up until speed falls to 70 kt, but this is not recommended in a cross-wind, as the shielding of the down-wind wing will cause it to drop as the incidence increases. Brakes are applied steadily as soon as the nosewheels are on the ground, and the elevator trim is wound fully forward to give maximum traction. Finally, if the detail is over, the after-landing check is completed and Nos. 2 and 3 h.p. cocks are turned off.

Three-engined approach procedure is almost identical with that for four engines, so far as the approach procedures go, with the addition of 500 r.p.m. on the three good engines to restore the lost thrust. There is next to no load on the rudder controls with either outboard engine cut, and no retrimming is necessary.

Take-off with two engines on one side being throttled back at critical speed presents no real problems at the weights used during conversion training, and the rudder control load can be very easily trimmed out (or held against the spring strut). Circuit drill is modified to give an extra 1,000 r.p.m. above the four-engined configuration, and with 8,500 r.p.m. on the two "good" engines the aircraft is flown down-wind at 1,500ft; wheels are lowered when beginning the crosswind turn; speeds and heights for the rest of the circuit are normal. Flaps are not lowered to 40 deg until completion of the final turn, and the final approach path is adjusted by reducing r.p.m. progressively until at 300ft, when the approach is tending to overshoot slightly, full flap is lowered for a normal landing. Flaps are left at 15 deg for all circuits, in order to keep down the speed around the airfield.

Overshoot procedure is standard; full power, 15 deg flap, and undercarriage selected up. If the aircraft is climbed at 130 kt the angle of departure from Mother Earth is certainly remarkable to any pilot used to the bellow of overtaxed piston-engines striving to thrust their metal hulk upwards at a meagre 500ft/min. No more troubles about overheating when maximum power is used; so long as the "7,000 r.p.m. minimum" rule is observed, the Ghosts give a ready response and feeling of security near the ground which, to the writer at any rate, was previously unknown.

After two day-training flights—one "light," one "heavy"—and an instrument-flying exercise, the day syllabus is complete. The instrument exercise consists of an airways clearance out of the London Control Zone, and of familiarization with the changed techniques demanded by the faster operation. As previously mentioned, the rate-half turn (1½ deg/sec) is adopted at high true air-speeds, and all initial procedures are completed at 180 kt (indicated) with flaps up. The conventional procedure-turn is discarded, and the 90 deg reversal method (as used widely in the States) adopted in its place. Pilots also practise flying on basic instruments (A.S.I., altimeter, turn-and-bank indicator and vertical-speed indicator). Since both turn-and-bank indicators and artificial horizons are driven electrically, one feels that another safeguard would be to fit stand-by vacuum instruments (a practice already employed in many "all-electric" aircraft).

Using the twin Marconi A.D.F. sets and the I.L.S. installation, there is nothing complicated about adherence to airways patterns. "Stacking" at low altitudes does, of course, impose a big penalty on endurance, and it is desirable to maintain at least 25,000ft to the destination should any delay be expected. Holding is carried out at 180 kt I.A.S. with inner engines fully throttled and outers at 9,000 r.p.m.

The Rebecca/Eureka distance-measuring radar is a very valuable piece of equipment, giving ranges of up to 150 miles, and ensuring the safety of operation in areas where distance from destination is not easily computed. An early descent *en route* is to be avoided, by reason of the low number of air miles flown per pound of fuel at low altitude. In cases of doubt the descent is not continued below 25,000ft until distance has been confirmed. Average length of descent from cruising altitude is 150 n.m., so the utility of the radar is self-evident.

The problem of integrating Comet operation with that of slower piston-engined traffic is, so far, present only on climb or descent; for instance, climb-out from London is liable to be impeded by other outbound clearances, and it is often necessary to reduce power to conform to any pattern. Normally, however, A.T.C. try to give a straight-through clearance. With flaps up, acceleration is rapid and it is necessary to reduce power some 300-400ft before reaching a cleared altitude to avoid overshooting. Much swift retuning of A.D.F.s is also necessary. One feels that such a constricted zone is not in keeping with jet requirements, and no doubt much thought is being expended on this matter at senior levels.

Generally speaking, the Comet fits into existing traffic patterns pretty well without disrupting low-level operation. But traffic-control services *must* be on the ball and alive to the difference in the two types of operation; it is on this aspect that the success of jet operation as a whole may well hinge. Unrealistic holding, as recently experienced at a well-frequented foreign airport, can have an adverse effect on commercial loads.

The clearance into the London Zone *via* airways, followed by a holding pattern at Epsom and an I.L.S. approach, completes the instrument exercise and the day flying.

Two details are flown at night, identical to those by day—"heavy" and "light." Cockpit lighting is an advance on anything I have yet experienced, and is very flexible, both red and white being provided. Instruments are not fluorescent, which is a pity, for again the thought of electrical trouble lurks in the mind. Landing-light switches are unfortunately placed to the port side of and behind the captain, who has to make an unnatural movement to select them. Use of the Comet's landing-lights (which are of the "diffused" type, as opposed to the "sealed beam" preferred by many pilots) is limited to a period of five minutes to prevent overheating and cracking. The separate filaments provided for taxying are so low-powered as to be almost useless. At night, the standard of instrument flying must be high, as the Comet, though naturally stable, can depart quite rapidly from a given altitude.

Training in England concludes with the check flight, which provides an opportunity, if required, for renewal of instrument rating at the same time. Emergency drills are covered fully and comprehensively before take-off, which is normally followed by clearance out of the London Zone on airways. At the training captain's request, the pilot carries out a series of basic-instrument manoeuvres, including "recovery from unusual positions"—such as a spiral dive or sustained high-*g* turn. Engine re-lighting and fire drills are also performed, followed by a homing to a radio aid on basic instruments. After obtaining clearance inbound, the pilot makes his approach and landing on full instruments, normally using I.L.S. and with one or two Ghosts inoperative.

Finally, various instructors sign-out the pilot concerned, who can now approach the M.C.A. for a Comet endorsement to his licence (at a fee of two guineas).

Route familiarization is the last stage in Comet conversion training. A captain completes two full trips on any particular route before being authorized to operate in command, and first officer/navigators are also given two full trips under supervision. In the latter case, the emphasis is on the navigational duties, calling for fast, accurate work without frills, of the kind upon which so much depends.

The economics of the jet airliner are not the writer's concern, although he is convinced that the gas turbine, fully developed, will prove to be the key to the new era of cheap long-distance travel. Perhaps it is too early, and one would be too bold, to predict the death of the long-range airscrew-driven airliner; but it already seems to the writer that transports of the future, fitted with the by-pass type of turbojet, will approach turboprop economy and yet retain all the advantages of the pure-jet machine.

No one can doubt that the jet airliner is here to stay and will continue to be used in increasing numbers on the world's airways. The pilot will welcome this progressive step in transport for the benefits it brings; but his elation must be sobered by thoughts of problems not yet encountered. In particular, he is well aware that progress cannot be achieved at the expense of safety standards. The advance represented by the Comet must be matched in many other aspects of air-transport if the benefits of jet travel are to be fully and quickly recognized.

P.R.W.D.

AB IGNITIO

PAST experience and present problems concerning ignition in aircraft engines were discussed at the third European Ignition Conference, organized by Lodge Plugs, Ltd., and held in London on Wednesday and Thursday of last week. Chairman of the two-day meeting was A. Cdre. F. R. Banks, C.B., O.B.E.

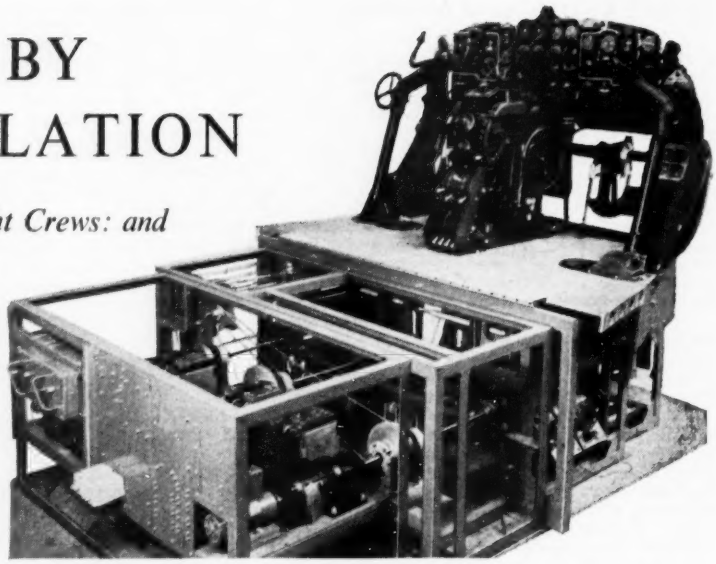
Several papers were submitted, and followed by questions on detailed points, by leading manufacturing firms, airlines and Government departments. The main topics considered in turn were: sparking plug performance on present-day fuels, the servicing of aircraft plugs, service experience, ignition analysers, magnetos and harness, and the development of high-energy ignition for jet engines.

Specific points studied included the effect of fuel lead-content on ignition performance, chemical cleaning of aircraft sparking-plugs, the effect of engine and plug life on sparking-plug firing voltages, the extent to which the airlines are fitting or using ignition analysers, the use of silicone materials for ignition-cable insulation, and igniter-plug design standardization on turbines.

The conference concluded on the Thursday evening with an informal dinner at the Savoy Hotel, which had been the scene of both days' discussions. We hope to make further reference to the papers in a future issue.

EDUCATION BY SIMULATION

Ground Training for Comet Flight Crews: and a School for Maintenance Men



The flight deck of the first Comet flight simulator is here shown in a partly finished state. The mechanism in the foreground reproduces control-forces. Large, remote units perform computation problems.

THE introduction into service of an aircraft such as the Comet inevitably involves a great deal of personnel-training. The old adage "practice makes perfect" is particularly applicable to those concerned with the operation and maintenance of airliners and, ideally, practical experience of their eventual tasks should be obtained by both air- and ground-crews before the first aircraft is delivered.

Such experience is hard to come by, since the manufacturer can seldom spare his prototypes for the purpose. Again, non-productive flying paid for by the airline is a very expensive process, to be kept to a minimum.

The situation is greatly eased by the use of a flight simulator, and few complex aircraft enter civil or military service today without the complementary introduction of such a device. The simulator for the Comet is the work of Redifon, Ltd. (Flight Simulator Division), of London, S.E.1. The first to be built was delivered to B.O.A.C. in last September, 24 months from the signing of the contract.

Basically, a flight simulator consists of a facsimile flight-deck of the aircraft concerned housed in a suitable building. Movement of any aircraft controls originates a signal, which is passed through a valve amplifier to an electro-mechanical servo unit. These units, when in operation, are continuously solving the many differential equations representing the behaviour of the aircraft, and they are designed to information supplied by the aircraft constructor. The servo units consist of multi-track potentiometers driven by reversible motors, and their output can be combined in suitable networks and integrated with other voltages introduced by external switches and Selsyn transmitters, which can introduce various "emergencies".

The final signals are then passed to the flight-deck instruments and also used to provide control forces, noises and other sensory indications. The equipment is therefore complex, yet it must be at least as foolproof in its operation as the actual aircraft.

The B.O.A.C. Central Training Unit at Meadowbank, Cranford, has considerable experience of simulator training. Courses begin with about three hours' familiarization, followed by repetition of standard flying procedures including let-down and navigational procedures involving every kind of emergency and mechanical failure. The repetition possible with a simulator can make a trainee's reactions a matter of sheer habit. Generally, crews can attain a higher standard in a shorter time than would otherwise be possible, and with reduced operational hazards and expenditure.

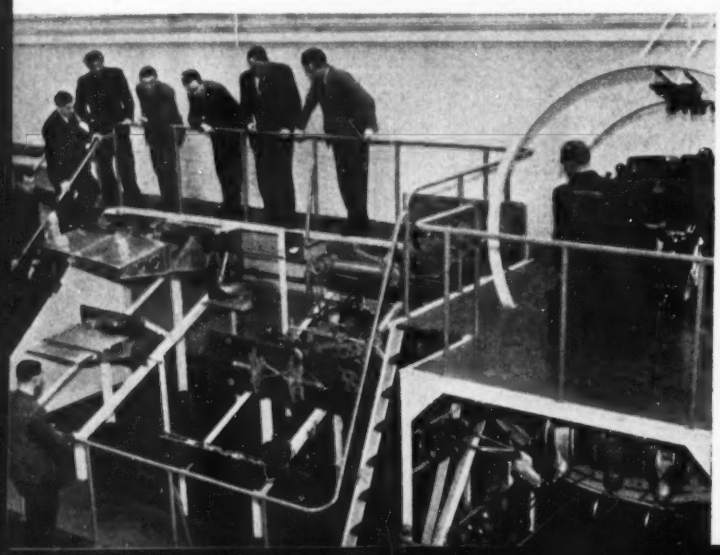
In a normal conversion course the captain and first officer each do 15 hours as pilot and 2½ hours as flight engineer; flight engineers concurrently complete 30 hours at the engineer station, making the total simulator time 35 hours. The Corporation's use of an earlier Redifon installation—representing the Stratocruiser—has been aided by the decision of the Ministry of Civil Aviation to count one simulated hour as equal to one flight hour for purposes of checking Instrument Flight Rating endorsements.

Naturally it is advantageous to have a simulator available for conversion to the new airliner even before the aircraft enters service; but striking economies can be achieved even if crews' continuous 180-day checks are the only utilization.

Turning now to the needs of servicing personnel, it appears that these will be met very well by the Servicing School opened at Hatfield by the makers of the Comet itself. The de Havilland company describe this institution as "a dissected Comet with its entrails laid bare" and it is used to give instruction in every form of Comet maintenance as well as assisting aircrew in pre-flight techniques.

The largest rig is that illustrated, which demonstrates the Comet's powered controls, landing gear and similar systems. Other installations are: the fuel system, which can be pressure-filled at 200 gal/min with a high-flash-point oil whose dielectric value corresponds to that of kerosine; a Normalair-built cabin-air demonstration circuit; other rigs dealing with all the Comet systems and power services; and a number of engine exhibits, including a genuine turbojet outside the building which can be started and run to full power from a Comet flight-deck inside the hall.

The demonstration hall is not yet complete and, as later types of Comet enter service, more equipment will be added to meet the training requirements. To date some 650 individuals, many of them nominated by B.O.A.C., U.A.T., C.P.A., S.A.A., the R.C.A.F. and Air France have already passed through the school.



This demonstration rig in the de Havilland Comet-servicing school concerns flying controls; the class are examining the operation of the aileron boosters and sheaving units.

HUNTINGS IN EAST AFRICA

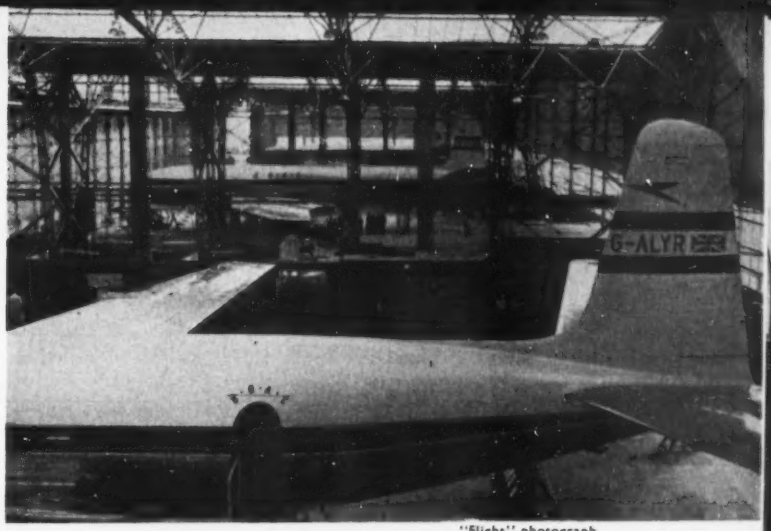
IT is announced that Hunting Aerosurveys (East Africa), Ltd., is to be the new name of the aerial survey company of the Hunting Group in East Africa. It was formerly known as the Aircraft Operating Company of East Africa, Ltd. The new name also reflects a change of management, as control passes from the Aircraft Operating Co. of Africa, Ltd., to Hunting Aerosurveys, Ltd.

Directors are: Sir William Ibbotsen, C.I.E., M.B.E., M.C. (chairman) a former Director-General of Civil Defence and Secretary to the Government of India; Mr. C. P. M. Hunting, a governing director of the Hunting Group; S/L. C. A. Hooper, prominent in Kenya aviation circles; and Mr. T. D. Weatherhead, O.B.E., director and general manager of Hunting Aerosurveys, Ltd.

Mr. H. H. Williams is general manager and alternative director.

COMET TURN-ROUND

Running the World's Fastest Air Services: Behind the Scenes at London Airport



Checks and Ghost-changes are carried out in the three-span alloy hangar at London Airport which houses the B.O.A.C. fleet of Comets.

"Flight" photograph

COMET G-ALYS, which is known to those concerned with its operation as "Yoke Sugar," is one of the fleet of eight Series 1 Comets in service with B.O.A.C. Our narrative centres on a brief episode in the working life of this aircraft, which was delivered to the Corporation early last year and has subsequently flown well over 1,800 hr in the course of proving, training and passenger-carrying flights. On Friday, April 17th, Yoke Sugar returned to London Airport after a 24-hr trip to Johannesburg. Early the following Monday it set off again for Tokyo. What follows is a piecing together of the jigsaw of activities entailed in accepting, turning-round and dispatching—on schedule—one particular Comet.

The story begins at about 3 o'clock on the morning of Friday, April 17th. At this time Yoke Sugar is nearing the end of the Cairo-Rome stage, and a W/T. message to that effect has been sent to Birdlip (the M.C.A. communications centre in Gloucestershire) and relayed by teleprinter to the appropriate B.O.A.C. departments at London Airport. From the estimated time of arrival at Rome, Station Operations work out times for the Rome-London leg and forewarn M.C.A. Met. Office, enabling forecasts of wind and temperature conditions to be prepared.

In another part of the airport, the progress of BA 116/088—flight number for this service—is being plotted by Movements Control, which is the central watching-point for all B.O.A.C.'s far-flung operations. From the blackboard headed "Comet Inward" we learn that BA 116, alias Comet G-ALYS, is 1 hr 47 min behind schedule and that replacement of a faulty navigation light at Entebbe was responsible for the delay.

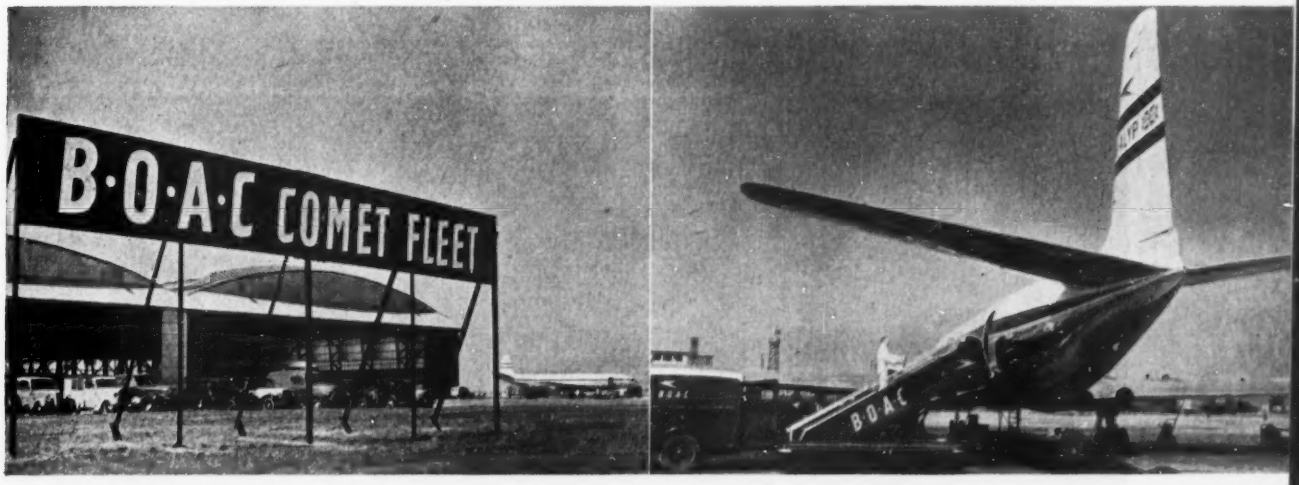
After a brief refuelling stop at Rome, Yoke Sugar takes off on the final homeward stage at 4.32 a.m. Ascending to 37,000ft, it sends further W/T. messages quoting position and times of departure and arrival (estimated), and requesting weather information. A few minutes before reaching Abbeville the Comet begins its long drift-down, joining Airway Amber 2 over Northern France. The pilots make R/T. contact with the Air Traffic Control Centre at Uxbridge, and are instructed on the method of entry to the London Control Zone. Yoke Sugar passes Ashford and, having now descended to 19,000ft, arrives over the Sevenoaks fan-marker at 6.53 a.m. to be handed on to London Approach. After orbiting once to lose more height the Comet follows the radio range to Epsom for its final approach to Runway 28L at London Airport. Talk-down guidance brings the aircraft through two layers of strato-cumulus cloud, and the journey is completed with touch-down at 7.03 a.m. Through that unavoidable delay at Entebbe, Yoke Sugar has arrived behind schedule, though it has caught up 20 minutes on the home stretch.

The aircraft taxies to its appointed place on the apron and, as the whistle of the Ghosts slowly fades into silence, the process of disembarkation begins. There are 36 passengers aboard—a full complement—of whom 21 have flown from Johannesburg. The remainder embarked at transit stops—six at Livingstone, two at Entebbe, five at Cairo and two at Rome. Two receptionists from the Passenger Handling Department conduct the voyagers from the aircraft to the arrivals lounge to prepare them for a speedy passage through Port Health, Immigration and Customs. First, however, messages are distributed and other needs attended to: one invalid passenger needs a wheelchair; four others are "inter-line" and are given cards bearing details of their connecting services (in this case, three to New York and one to Belfast). In addition, baggage is returned, together with wheeled baskets for convenience in moving belongings through Customs. By 7.30 p.m. the first passengers have emerged from Customs and, if they so choose, can board the B.O.A.C. coach for a five-shilling ride to Victoria.

Meanwhile, the rest of the Comet's payload is being transferred from the aircraft to two vans from Freight Allocation and Services. Manifests which are signed by the captain in the presence of a Customs officer show that 544 kg of mail and 334 kg of cargo are being off-loaded and taken to the import transit-shed. Armed with

After its check and engine-changes a Comet emerges from the hangar (left). Later, having been towed back to the terminal area it is made ready for its next service; one of the first steps is to take aboard galley equipment (right).

"Flight" photographs



"Flight" photographs

Mail (left) and freight are stowed aboard the Comet, whose two cargo compartments have a total capacity of 385 cu ft.

COMET TURN-ROUND . . .

these manifests, the Excise men check the quantity and contents of the various items shown, and mail is swiftly transferred to a G.P.O. van. At the same time quick clearance has been arranged for the more urgent pieces of cargo—Press photographs, newsreel films and newspapers. Disposal of the remainder of the load, which includes samples of raw material and of tinned meat, depends on the instructions given by consignees.

Having watched Yoke Sugar's passengers and cargo safely off the aircraft, we turn to the crew—Capt. MacIntosh, 1st/Off. Humphries, R/Off. Walker, Eng/Off. Duffey, Steward Steinberg and Stewardess Mellor. They too have been through Customs and their duties are almost—but not quite—finished. Galley equipment and dry stores must be returned by the cabin crew to the Aircraft Catering Section. Paying-in of bar takings is another task for the steward. The flight crew visit Movements Control, where the journey log-book is handed in, and return their maps and manuals to Central Operations Services.

Each member of the crew will return to Comet Fleet H.Q. next day for the "voyage conference," which is, in effect, a specialist de-briefing. Written "voyage reports" have already given the Fleet an outline sketch of the complete service, and personal interviews provide detail and colour. In this way a constant check is kept on every aspect of Comet operations, ensuring that experience in pioneering the jet transport will be turned to good account.

While its crew take their leave of London Airport, the Comet is being towed by tractor to the three-bay hangar of greenish aluminium in which the jet airliners are serviced and maintained. The Fleet Planning Officer, who is responsible for utilization, has already decided that Yoke Sugar's next trip will be Flight BA 916/002. This service, to Tokyo, is not due out until 9 o'clock on Monday morning, so the Fleet Maintenance Engineer and his staff have nearly 48 hr—a more than ample allowance—in which to prepare the aircraft for duty. For half this time, in fact, Yoke Sugar will be kept in readiness as the stand-by aircraft.

Inspectors make a visual check for leaking kerosine before the Comet is admitted to the hangar, so that if de-fuelling should prove necessary it can take place in the open. There are no leaks, so Yoke Sugar is quickly wheeled inside for the Check I inspection which will permit it 75 hr of virtually maintenance-free flying (about 17 hr more than it will require for the return trip to Tokyo). Four newly prepared Ghost turbojets are aligned in the hangar, replacements for those now installed, three of which are due for their second 150 hr flame-tube inspection; the fourth, having completed the 450 hr overhaul period (soon to be raised by 150 hr) will be sent back to de Havillands at Hatfield. While cowlings are being opened, the inspector in charge scrutinizes the entire aircraft, having already ascertained, from the technical log aboard, whether or not any "B snags" occurred *en route*. Under the supervision of a foreman, two charge-hands have deployed a sizeable force of ground engineers to various portions of the Comet's anatomy : eight engine fitters, ten airframe and hydraulic fitters, three electricians, two instrument engineers and two radio engineers. A painter touches-up any signs of wear and tear due to weather, and an upholsterer repairs any slight damage to interior fittings. Half a dozen cleaners make up the team.

Within an hour all four Ghosts have been taken out of their wing mountings and similar, though less obvious, progress is being made elsewhere on the aircraft. The following afternoon (Saturday), some 250 man-hours later, a crew headed by Capt. A. V. Rix arrive at the hangar to give Yoke Sugar the air test which is mandatory after replacement of two or more engines (or a control surface). Ballast has been placed in the forward hold, and engine fitters have completed final adjustments to the fuel-pump settings.

The usual pre-flight checks are made by the captain and his crew—1st/Off. Crooks, Eng/Off. Taylor and R/Off. Holley. It can safely be assumed that the test-flight duty is not too irksome for the crew, since this is an especially bright and sunny afternoon, and the formalities associated with passenger-carrying are absent. A.T.C. provide the necessary clearance and at 2.50 p.m. Yoke Sugar takes off for a 52-minute flight, in the course of which a full pressurization test is carried out. Behaviour of the engines and of all systems is carefully checked. On return, Capt. Rix declares the aircraft serviceable; the only fault discovered was a defective micro-switch, which is immediately replaced.

In preparation for Monday's flight to Tokyo, Yoke Sugar is "dressed for service." The cabin is swept out, curtains are straightened, lap-straps folded, head-rest covers placed in position and carpets laid. On Sunday the aircraft remains inactive in the Comet hangar, but preparations for the morrow's departure are under way in other parts of the airport.

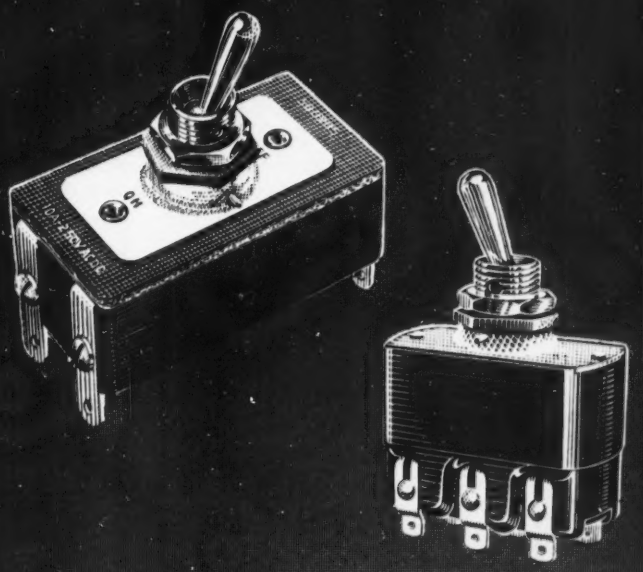
Sector-distance, winds and temperature all affect the amount of kerosine to be delivered by the Shell refueller (left); a Murex high-power starter is visible in this view. The engineer officer (right) checks the amount of fuel taken aboard. Note the new dimpled tyres (page 553).

"Flight" photographs

PAINTON

By Appointment to the Professional Engineer....

ATTENUATORS · FADERS · STUD SWITCHES AND TOGGLE SWITCHES
WIREWOUND POTENTIOMETERS · HIGH STABILITY CARBON RESISTORS
WIREWOUND RESISTORS · PLUGS AND SOCKETS · TERMINALS
KNOBS DIALS AND POINTERS



TOGGLE SWITCHES

10 Amps./250v. AC/DC Range
Double Pole ON/OFF Operation
Fully R.C.S.C. Approved

Type 501085
6 Amps./250 v. AC/DC
Double Pole Change-over Operation

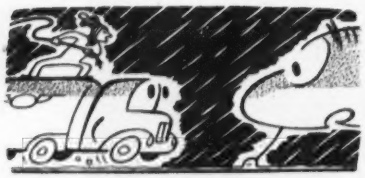
PAINTON

Northampton England

Landscapes in Oils (3)

A Nicht at Prestwick

BY BERNARD HOLLOWOOD



IT is bitterly cold ; driving sleet and a spine-chilling wind. (Cue for sound effects.) At 2.40 a.m. a bell rings in the quarters of the *Esso* refuelling unit at Prestwick Airport and the crew musters for immediate action.

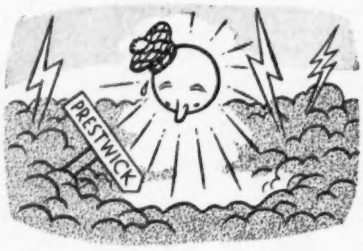
Out on the tarmac a Scandinavian freighter taxies through the gloom and slush. The refuelling team is ready. The supervisor greets the Scandinavian flight engineer, takes his order for fuel and lubricants, and gives the signal for operations to begin . . . .

They are a hardy lot, these Prestwick refuellers. Dour Scots with highish cheek-bones, broad shoulders and sinewy limbs. (Cue for pibroch an' a' an' a'.) Theirs is a tough job. The huge tank-trucks, or " refuellers," move in and halt at a respectful distance from the freighter, the hose is unwound, a

ladder is placed against a wing and Mac clambers up and spreads wing-mats on the ice-coated metal.

It is no joke up there on the glassy convex wing, manhandling a weighty nozzle on the end of a heavy length of hose and knowing that an aircraft's safety depends on your efficiency and scrupulous observance of the *Esso* refuelling code. The glazed metal is treacherous, and the tarmac far below is hard, very hard.

Why, mon, it is cold enough standing here in the shelter of the tank-truck — much too cold for the artist to ply his pencil. We observers shiver and curse the weather, and a proud Scot grins and tells us that the Met. Office reports conditions in the south, at Northolt and London Airport as far, far worse. Prestwick, he tells us, has very little " weather," virtually no fog and the finest commercial location in all Britain. It is just too bad, he says, that our visit should happen to coincide with a freak



storm. (He was right, too : Prestwick *does* avoid most of the dirty weather.)

The Scandinavian is away—her tanks full — bound for home.

An hour later we are out again, this time to pump three thousand gallons of fuel into an American air-liner. Once more the tank-trucks move out into the sleet, and the work of feeding the aircraft begins — methodically, very carefully.

Infinite precautions are taken by Esso to ensure that fuel reaches the airports in first-class condition, free from water and foreign bodies, but these precautions mean nothing until the fuel has been safely stored in the tanks of the aircraft. This last link in the chain of operations from refinery to aircraft is vital, and the refuelling team knows it. So the order of the day, every day, is ceaseless care and vigilance.

The filters (which remove particles smaller than 10-Micron size), the sumps, sight glasses and drain cocks, are checked every morning and after every filling. Every scrap of equipment is checked, and rechecked, and kept as clean as a Scottish whistle . . . .

Three thousand gallons . . . . On your marks ! Tank-trucks checked, ground wires (to dissipate static electricity) fixed, fire extinguisher at the ready, ladders set up . . . .

Crewman boards wing, takes care to prevent hose touching de-icer boot or leading edge. Wing mat in place. Static bonding wires connected. Tank cover opened, contents gauged, nozzle inserted. And to keep the sleet out of the tank the nozzle is fitted with a protective hood . . . .

Supervisor makes final checks . . . signals for pumping to begin . . . .

And when the job is done and everything is ship-shape again we go back to the friendly warmth of the *Esso* hut and hear the American take wing for the Atlantic and Gander. Sandy tells us that Hibs are a great side this season ; the supervisor tells us exactly how many million gallons of fuel are dispensed each year by his unit and we forget the figure ; Mac tells us (with gestures) that the language problem is sometimes a li'l tricky and that litres and other un-British measures ought tae be abolished. And Joe produces excellent mugs of tea.

Aye, there's a lot to be said for

Prestwick and Prestwickians, even on a bitterly cold nicht wi' driving sleet and a spine-chilling wind. (Cue for sound effects and important final announcement)—

It pays to say

Esso

FOR ALL PETROLEUM PRODUCTS

ESSO PETROLEUM COMPANY, LIMITED, 36 QUEEN ANNE'S GATE, LONDON S.W.1

COMET TURN-ROUND . . .

At 11 a.m. one of the Service Control staff opens a file marked BA 916/002, which is to contain working copies of all the paperwork connected with the payload on each sector. Movements Control forwards to Service Control an A.P.S. ("aircraft prepared for service") form, which quotes the empty weight and loading index. Added to this is the weight of the crew and their equipment. Seats in the aircraft have already been allocated to passengers, and Service Control draws up the seating plan, keeping a copy for the steward. Allowance is made on the load-sheets for 804 kg of Post Office mail and 4 kg of diplomatic mail, which are typical weights reserved for mail on this service.

By evening time, Bookings at Airways Terminal have forwarded a final passenger-list which tells how many seats have been sold, held or released on each sector. An indication of the fuel requirement is given by Station Operations, so that Service Control can now provide Freight Allocation and Services with an accurate idea of the amount (and volume) of cargo which may be stowed aboard Yoke Sugar. Diagrams are prepared for the loaders, showing the physical disposition of the various items of cargo. This ensures that freight can be unloaded conveniently and is suitably arranged in relation to the c.g. safe limits. If the mail load or the total weight of passengers and their baggage turns out to be lighter or heavier than the working estimates, adjustment can be made to the cargo uplift.

With the exception of the freight manifest, which is obviously subject to last-minute alterations, Service Control is also responsible for the preparation of all those documents, known collectively as ship's papers, which form a declaration of the entire aircraft and its contents, for presentation to Customs authorities at every airport on the route.

Crew duties begin 24 hr before departure. The flight crew detailed to take Yoke Sugar on the first stage of its trip to Tokyo—Capt. Bainbridge, 1st/Off. Grey, R/Off. Pozzi and Eng/Off. Lye—have been issued with all the necessary operating manuals and Movements Control have given the captain the names of passengers requiring special care or attention. At Meadowbank, Cranford, three miles from the airport, the two pilots practise instrument let-down procedures for airports *en route* in the Link trainer before joining other crew members at Dormy House, near Sunningdale. If a service departs between 12 p.m. and 9 a.m.—and in this case departure time is exactly 9 o'clock on Monday morning—B.O.A.C. crews are normally accommodated at Dormy House during the preceding rest period. Special instructions have also been given—by the Fleet Catering Officer—to Steward Nicol and Stewardess Green, and their main duty on the pre-departure day is to draw stores and equipment from the Aircraft Catering Section.

By 7.30 a.m. on Monday morning a tractor has returned Yoke Sugar to the apron, and stewards on stand-by duty install and arrange the bar, galley and cabin stores drawn by their colleagues the previous day. The catering check-list is a lengthy one, including not only the usual lightweight food-and-liquid containers and cutlery, but also Elizabeth Arden kits for lady passengers, an electric razor, 36 cellular blankets, writing paper, "Flight Companions" and a Penguin library.

Meanwhile, in Station Operations, Stn/Off. Newham has been at work since 6.45 a.m. on the preparation of a flight plan for the London-Rome sector of the journey. His first actions were to obtain an estimated "empty tank weight" from Service Control and to check the forecast weather on the route, at the destination and at alternative airfields. Another department, the Duty Room, having checked the forecast and found it favourable and ascertained that the aircraft is serviceable, has sent "met. release" and "mechanical release" to Airways Terminal at Victoria. This permits a coach to set off for the airport at the scheduled time of 7.30 a.m. with those passengers who are not making their own way to the airport.

At about the same time as the coach leaves Victoria, the Shell tanker is driven up to the Comet and a total uplift of 14,500 kg of kerosine begins to flow through the underwing refuelling valves into the integral and centre section tanks. Having decided, in view of the favourable weather forecast, that this amount of fuel (which is just over the minimum allowance for the sector) is sufficient, Mr. Newham has—about 5 min previously—passed on the necessary refuelling chit to Flight Section on the tarmac. At 7.40 a.m. clearance for Yoke Sugar is filed with L.A.P. Traffic Control, which passes on the information to Uxbridge. This forewarning enables the airways controllers to give the Comet its required place in the pattern of air traffic going out of London.

The flight crew, who reported to Movements Control at 6.45 a.m. to pick up the journey log-book, have now made their way to Station Operations, where 1st/Off. Grey studies the flight plan and finds it satisfactory. Capt. Bainbridge adds a written endorsement. Before boarding the aircraft to make their pre-flight checks, the crew are provided with up-to-date information on weather and route facilities—as far as Beirut—by the M.C.A. Met. Office and by the M.C.A. and B.O.A.C. briefing units. For the captain there is a final call at Service Control, where he collects the ship's papers, while the engineer checks the quantity of fuel being taken aboard.

A Passenger Handling receptionist meets the coach at 8.15 as it draws up outside the main departure building. Passengers are conducted to the B.O.A.C. ticket counter, where documents are examined in preparation for passage through Customs and immigration to the final departure lounge. Passengers who have made their way direct to the airport continue to arrive during the next 10 to 15 min, and lists quoting the names, weights and destinations of travellers are transferred from the ticket counter (by means of a Lamson vacuum tube) to the first-floor room where Service Control is making final amendments to the passenger manifest. Deadline for passenger arrivals is 8.30—half an hour before departure—and, if any of the travellers have failed to show up, the extra space is made available for cargo, if required. Last-minute arrangements, which might enable a late arrival, particularly a long-distance passenger, to take his place in the aircraft, can be made only at the discretion of the Duty Officer.

Shortly before this deadline, warning of the impending departure is broadcast: "Here is an announcement for passengers on B.O.A.C. Comet jetliner Flight 916 to Rome, Cairo, Bahrain, Karachi, Delhi, Calcutta, Bangkok, Manila and Tokyo. Will you please take leave of your friends, collect your hand baggage, have

"Flight" photograph

About 15 min before chocks-away time passengers are driven out to the Comet (above) and take their places in the 36-seat cabin. Empty seats, if any, will quickly be taken up en route. (Right) A view of the apron at London Airport, with a Comet on the extreme right.

"Flight" photograph

DEPARTURE: In the bright sunshine of a spring day, this Comet was pictured last week as it left London Airport for Rome.

COMET TURN-ROUND . . .

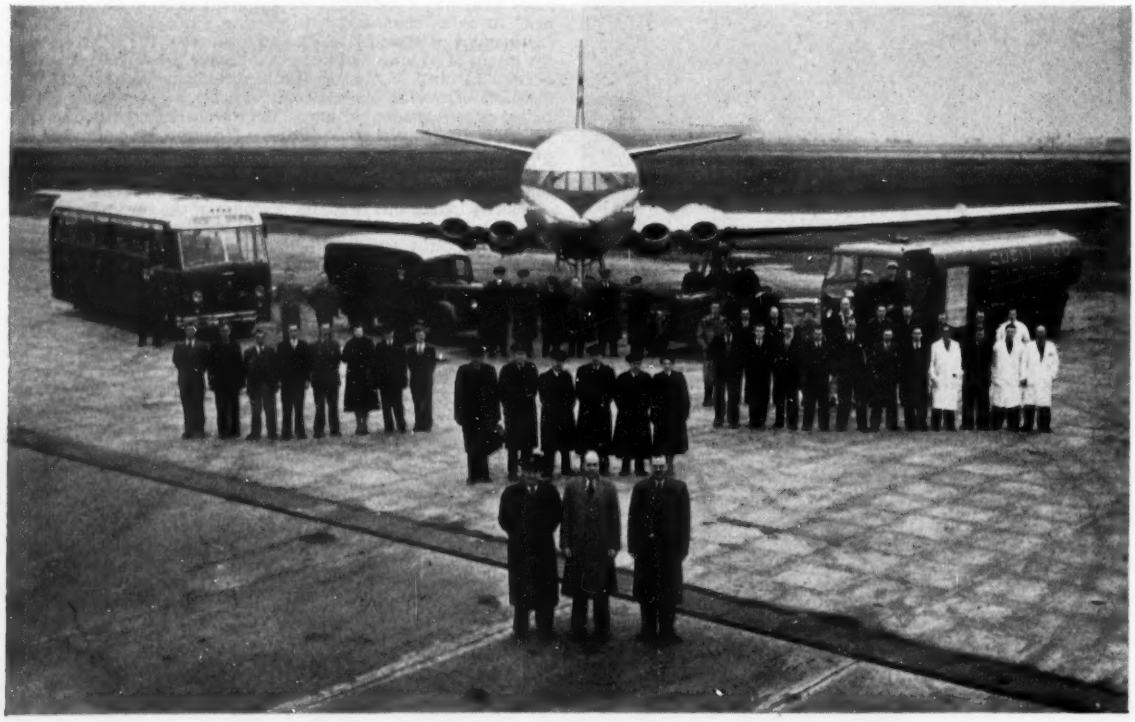
your passports ready and follow the green light to Customs and immigration." By 8.45 a.m. the steward and stewardess have welcomed the passengers aboard and ensured that each is comfortably seated. Yoke Sugar is ready to leave London, with its payload of 31 passengers (including three infants), plus 673 kg of baggage, 123 kg of diplomatic mail (an unusually large amount, since a Queen's Messenger is among the passengers on this flight), 736 kg of Post Office mail, and 295 kg of cargo. A.T.C. have assured clearance to take off, engines are started and at once the chocks are waved away—there being no need to allow a warming-up period with gas turbines. During the taxi-run out to the airfield a brief pre-take-off check is made by the crew. Final clearance is given and the aircraft turns on to Runway 10R; the four Ghosts are opened up, the brakes released and the Comet unsticks at 9 a.m. precisely.

While in the vicinity of London it must conform with the prescribed traffic pattern, but soon it is clear to climb to its cruising altitude.

Just one hour later Yoke Sugar is over Dijon, well on its way to Rome. R.B.

THE TEAM BEHIND THE COMET: Originally published in "Flight" of March 6th, the photograph below is reproduced again to illustrate a cross-section of the many people at London and overseas airports who have contributed to B.O.A.C.'s successful first year of operations of jet airliners. Those shown are as follows:—

The trio in the foreground are (centre) the Comet Fleet manager (Capt. M. J. R. Alderson), the officer i/c. training (Capt. E. E. Rodley, left) and the fleet maintenance engineer (Mr. R. A. V. Dismore, right). Behind them are a crew—captain, first officer, engineer officer, radio officer, steward and stewardess. The line-up of eight people on the left are the flying staff administration, fleet communications, fleet liaison and operations planning and operations officers; the fleet secretarial staff representative; fleet navigation officer; and representative of the flying-staff services. In the front rank of the squad on the right are the senior inspector, technical officer, fleet supplies officer, fleet planning engineer, base engineer superintendent, foreman, two chargehands, leading hand, instrument instructor and chargehand (instruments). The second rank consists of the technical records representative, methods planning engineer, a technical officer, engineering secretarial-staff representative, chargehand (electrical), leading hand (sheet metal), chargehand (hydraulics), fitter, inspector (instruments) and leading hand. Behind them are the refueller crew of two. Under the port engines are the tractor crew of four, and beneath the nose (reading now from right to left) are a security warden, an aircraft loader, station operations representative, officer i/c. aircraft catering, officer i/c. service control (representing traffic branch—passenger, freight and mail handling), and the station duty officer. Next is seen the freight and catering equipment van and its driver, then two M.C.A. personnel, the tarmac marshal and the air-traffic controller. The remaining member of the team is the passenger-coach driver.



JET AIRLINE ANNIVERSARY

B.O.A.C.'s Progress in Twelve Months of Comet Operations

SINCE the afternoon of May 2nd, 1952, B.O.A.C. have been operating scheduled services with 36-seat de Havilland Comet Series 1 jet airliners. When, a few days before the historic departure for Johannesburg, Sir Miles Thomas formally announced the Corporation's plans for introducing the Comet, he referred to the occasion as one of "high promise and significance" and to the aircraft as a "superb product of British invention, enterprise and skill." Until a few months ago B.O.A.C. had remained the first and only operator of jet airliners and, in fulfilling the promise of those early days, the British airline has evoked the admiration of passengers and the envy of other companies throughout the world.

Competitors in other countries, particularly those airlines which have not yet finally resolved to enter the jet-transport field, or those manufacturers whose designs are out-dated by the Comet, have subsequently implied that Britain's jet airliner is an uneconomical vehicle operated solely for reasons of national prestige. While freely admitting that the Series 1 version now in service can be used to best advantage only on certain carefully selected routes, B.O.A.C. can refute allegations that Comet services are run on a basis of subsidized experiment. In a firm reply to such criticisms, the Corporation states that: ". . . Comets, which have been operating with high load-factors, have made sufficient profit in the year to cover interest on capital. This is on a realistic costing basis, exactly as applied to all the Corporation's fleets, and including the cost of route-proving and training spread proportionately over the life of the aircraft. On the routes on which B.O.A.C. have been operating Comets, connecting London with Johannesburg, Colombo, Singapore and Tokyo, an average load-factor of 75 per cent shows a profit." Figures below prove that this figure has, in fact, been handsomely exceeded.

The Corporation's confidence in the Comet has been demonstrated by the rapidity with which the scale of operations has expanded. The fleet of eight Series 1 aircraft are now flying eight long-distance return services a week, which means that Comets cover an average of 17,000 miles daily. As recounted elsewhere in this issue, the serviceability of the aircraft, despite their novelty, has been excellent. Including time spent on training and route-proving flights, the equivalent annual utilization per aircraft is approaching 2,000 hours—or nearly a million miles.

"Flight" photograph

FLASHBACK: Comets have now completed a year of scheduled passenger service with B.O.A.C. This photograph recalls the occasion of the first departure of G-ALYP to Johannesburg.

Comets of B.O.A.C. are now operating along four routes; details of these services, together with a map, appear on page 547. The sequence in which these services were introduced, together with other main highlights in the Comet story to date, is as follows :—

May 2nd, 1952.—Opening of original weekly return service between London and Johannesburg.

May 15th, 1952.—Beginning of series of 18 development and training flights to Singapore.

June 1st, 1952.—Frequency of Johannesburg service increased to three return flights weekly.

August 11th, 1952.—Opening of weekly return service between London and Colombo.

October 14th, 1952.—Opening of weekly return service between London and Singapore.

October 31st, 1952.—Frequency of Singapore service increased to two services weekly.

February 8th, 1953.—B.O.A.C.'s first 10,000 hr of Comet flying completed.

April 3rd, 1953.—Opening of weekly return service to Tokyo.

April 13th, 1953.—Frequency of Tokyo service increased to two return services weekly.

Delivery of the fleet of nine Series 1 Comets was completed on September 30th, 1952, when G-ALYZ was handed over to B.O.A.C. Unfortunately, this aircraft was damaged beyond repair

RESULTS OF THE FIRST YEAR OF SCHEDULED COMET SERVICES

Route	Inaugural date	Frequency	No. of return flights	Revenue hours flown	Revenue miles flown	Revenue pass. miles flown	Revenue pass. carried	Freight, excess baggage and dipl. mail carried (short tons)	Mail carried (short tons)	Revenue pass. load-factor	Capacity short ton-miles available	Revenue short ton-miles flown	Overall load-factor
Johannesburg	2.5.52	1 weekly, 3 weekly from 1.6.52	135	4,775	1,758,668	55,273,420	13,442	112	207	88	9,652,291	7,751,528	80.3
Colombo	11.8.52	1 weekly	33	1,103	397,238	11,655,520	3,630	41	23	81.9	2,134,361	1,532,940	71.8
Singapore	14.10.52	1 weekly, 2 weekly from 31.10.52	45½	2,038	725,179	22,665,010	6,116	60	78	87.3	3,972,071	3,228,559	81.3
Total (1)	—	—	213½	7,916	2,881,085	89,593,950	23,188	213	308	86.9	15,758,723	12,513,027	79.4
Total (2)	—	—	248½	9,450	3,409,000	104,600,000	27,700	252	365	86	18,572,000	14,549,000	79

Total (1): Actual results achieved between the inauguration of Comet services on May 2nd, 1952, and March 31st, 1953.
Total (2): As above, plus estimated results for the period April 1st-May 1st, 1953; these figures take into account traffic carried on the London-Tokyo service, which opened on April 3rd.

Figures for scheduled services only are included in the table above; the consistently high load-factors achieved with Comets is of great significance. In addition, the Comet Fleet has performed some 50 hr flying on contract, carrying 265 passengers over a total of 15,400 miles.

JET AIRLINE ANNIVERSARY . . .

in a take-off mishap at Rome on October 26th; all the passengers and the crew escaped injury and the official inquiry showed that the incident was not caused by any malfunctioning of the aircraft or its engines. But for the loss of this Comet, it would have been possible to operate an extra Comet service weekly, probably on the Johannesburg route.

The Corporation consider that their Comet 1 programme is now complete. Some re-routing of services may take place in the future, but no definite plans have yet been made. It seems likely, however, that before long two of the Comet 1s will be hired more or less permanently to South African Airways. Such a move has been under high-level discussion for some time and a number of South African crews have already been trained on the Comet.

The two Comets on hire would be operated in South African colours on the Johannesburg route, which is, in any case, jointly operated by B.O.A.C. and S.A.A., revenue being shared between the two Corporations. At present the B.O.A.C. Comet fleet has 40 trained crews, some of whom would presumably become available for Comet 2 operations when the agreement with S.A.A. takes effect.

It is already apparent that, other things being equal, the jet airliner has a far greater capacity for work, in terms of ton-miles per annum, than the conventional airliners operating most of the world's long-range routes. There is, however, a trend towards reduction in the number of hours flown annually by Comet crews; a pilot may, for example, fly 600 hours in a year in Comets compared with 900 to 1,000 hours on other B.O.A.C. types. The simple fact that the Comet flies so many more miles in an hour demands a corresponding degree of concentration from the men who fly it, and crews are frequently "slipped" on all the B.O.A.C. jet routes.

The captain who brought the Comet into London Airport after its first service to Tokyo was, understandably, rather embarrassed by queries from the Press as to his feelings about the trip, since he had flown that particular aircraft only on the final stage—from Rome to London. Whereas the aircraft are absent from London while operating a service for a maximum of five days, crews are normally away for a fortnight at least.

A typical example of the Comet slip system is provided by the movements of the crew, headed by Capt. Bainbridge, which left London Airport on the Tokyo service on April 20th, as recorded in "Comet Turn-round" (page 541). This crew handed over to another at Rome, where they remained until Wednesday; then they took BA 774, a Colombo service, on to Karachi; they remained at Karachi until last Saturday, April 25th, when they took a Tokyo-bound Comet as far as Bangkok. Next, on Monday, they were due to fly the Comet operating BA 780 to its destination—Singapore. The following day, Tuesday, found Capt. Bainbridge and his crew on the Singapore-Bangkok stage of service BA 781. Yesterday (Thursday) they flew nearer home—as far as Karachi—on BA 917, which is a London-bound service from Tokyo—but will not return to London Airport until next Tuesday, May 5th, when they begin a well-earned rest.

B.O.A.C.'s forward planning of jet services is, of course, dependent on the delivery and performance of later versions of Comet. As early as possible in 1954, the Corporation intend to open the first transatlantic jet services—between the United Kingdom and South America—with Avon-powered Comet Series 2s, 12 of which are on order. At the same time, exploratory flights over the North Atlantic will begin to gather data on upper-air conditions. This will be an essential preliminary to the inauguration—in 1956/57—of North Atlantic services with the larger, longer-range Comet 3s, a fleet of which have tentatively been ordered. The existing Avon-powered Series 2X prototype, which is the property of the Ministry of Supply, will probably be lent to B.O.A.C. for initial South Atlantic proving during the coming summer; and delivery of the first production versions is expected to begin later this year.

Meanwhile, a great deal of valuable experience is being accumulated by the Comet Fleet with its existing Series 1s. Already two of the most senior pilots—Capts. Majendie and Rodley—have completed over 1,000 hr of Comet flight-time.

While the introduction of jet airliners can fairly be described as a bold and imaginative step for any airline to take, it would be wrong to regard it as a step into the unknown. The problems involved were the subject of a great deal of study and experiment long before the first passenger-carrying Comet left for South Africa a year ago. One of the most encouraging aspects of subsequent progress has been the way in which the original long-term predictions have been realized. The cruising procedure which was evolved for the original long-range proving flights, for example, has never been substantially altered. It can be said that, from practically every aspect of airline operations, the Comet has brought no new problems of its own. It has, however, revealed and emphasized existing deficiencies—in communications, navigational aids, weather forecasting and traffic procedures. B.O.A.C. have never asked for traffic priority for the Comet at any of its destinations or calling-points, and this policy has proved to be both practical and politically wise. It should not be inferred, however, that some form of "jet priority" will not eventually become a standard procedure during the period of transition from piston-engined aircraft. Such a development will not be forced by B.O.A.C., but may evolve naturally from the mutual desire of a large number of jet-operators to reduce costs due to avoidable holding in crowded air-traffic zones. It should be added that, unless traffic procedures are greatly streamlined, existing problems will be greatly aggravated by the advent of more and more "impatient" jet airliners.

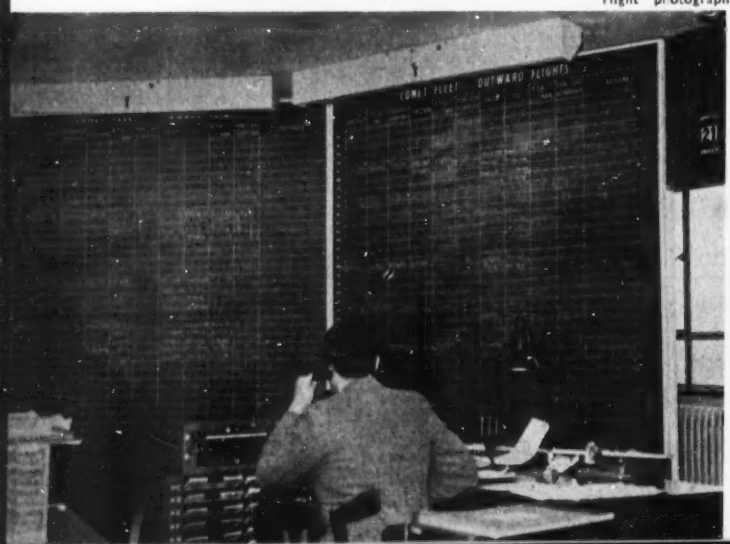
The progress of Britain's jet airliner has been watched with interest and admiration all along the routes which it operates, and civil-aviation authorities abroad have shown great goodwill in paving the way for smooth working of the new B.O.A.C. services. One essential point about the Comet, however, does not appear to have been sufficiently publicized: the fact that its runway requirements are no more than for any lively piston-engined transport of comparable size and capacity. The Comet, as an I.C.A.O. Category "A" Aircraft, has been certificated to the latest British airworthiness requirements, which represent the most ambitious performance code in the world. There has been a tendency to associate the Comet's runway requirements, and the associated take-off and landing performance, with the fact that it is a jet aircraft and to overlook the exacting regulations which it has been designed to meet.

SOME SENIOR MEMBERS OF THE COMET FLEET

Manager, Capt. M. J. R. Alderson; Flight Captain, Capt. A. M. A. Majendie; Operations Superintendent, Capt. A. P. W. Cane; Office i/c. Crew Training, Capt. E. E. Rodley; Fleet Maintenance Engineer, Mr. R. A. V. Dismore; Fleet Operations Officer, Mr. J. N. Davies; Flying Staff Administrative Officer, Mr. N. Jupp; Fleet Radio Officer, R/O. R. A. Dolman; Fleet Engineer Officer, E/O. W. L. Bennett; Fleet Navigation Officer, N/O. C. Evans; Fleet Planning Engineer, Mr. H. W. Bradley; Maintenance Engineer, Mr. R. E. Wright.

Taken in Movements Control at London Airport on April 21st, this photograph shows the section where the progress of Comet services is constantly under watch. Five Comets were abroad at the time, with two more due for departure the next day.

"Flight" photograph

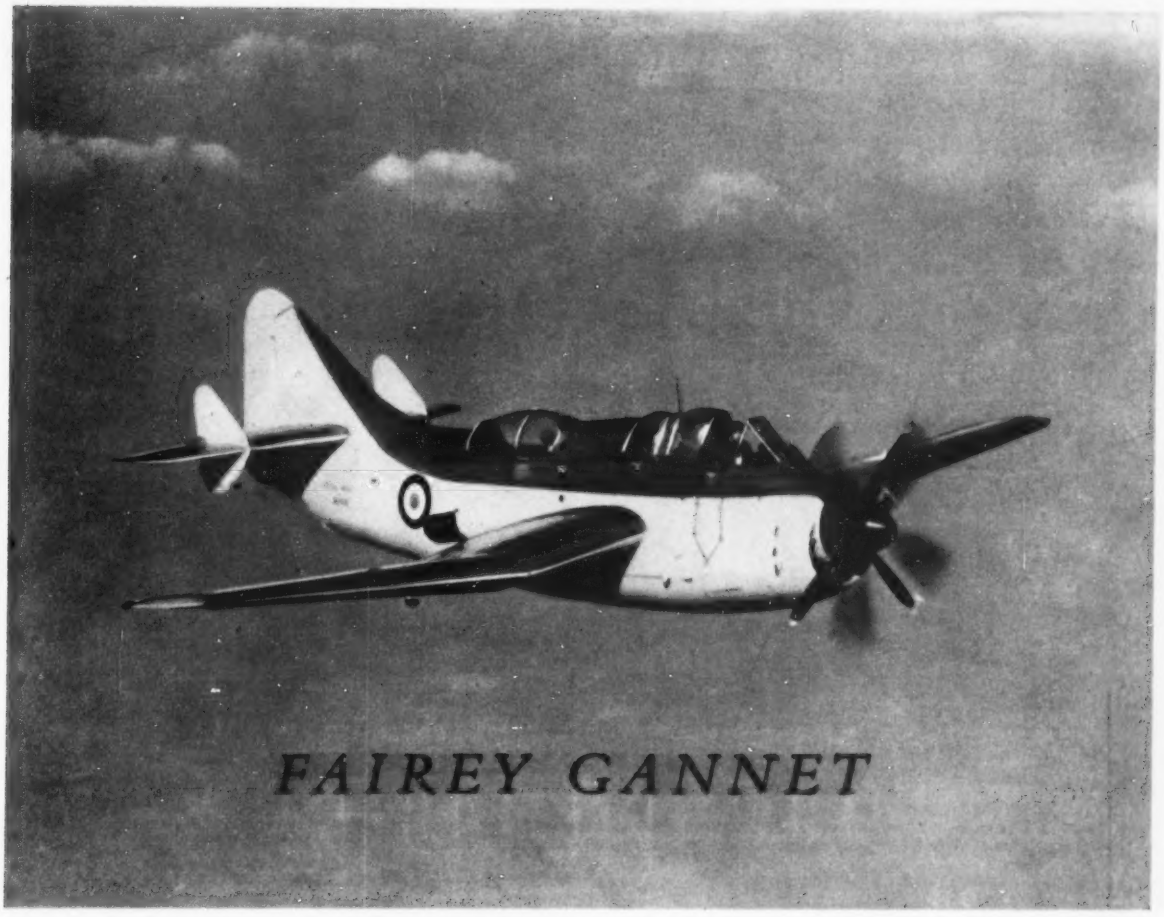


TILTMAN LANGLEY PROGRESS

SPEAKING at the annual general meeting of Tiltman Langley Laboratories, Ltd., Mr. A. Hessell Tiltman (chairman) said that the company's turnover had shown an increase of 25 per cent on the previous year's total.

Stating that the authorized capital had been increased to £30,000, Mr. Tiltman said that work in hand would keep all departments working to capacity for many months to come. The demand for the company's specialized technical services continued to increase, and during the year the staff had successfully tackled a number of technical problems presented to them by the M.o.S. and other Government departments and by industrial organizations.

The company had received its first large-scale production order from a Government department, covering the manufacture of one of the devices designed and developed by Tiltman Langley. It was thus becoming apparent that manufacturing facilities should be expanded to meet pilot-production and, probably, large-scale production orders for the equipment which the company was developing. It might be that a separate manufacturing company would be formed, in which Tiltman Langley Laboratories would hold a controlling interest. The Board considered it desirable to separate research and prototype work from pure production.



THE Royal Navy, which has to maintain sea communications, regards counter-measures to the submarine threat as of first importance. Much of the new anti-submarine equipment is specialised, and demands unique capabilities and characteristics from the aircraft employed. To cover this feature of defence the Fairey Gannet is in super-priority production, and has also been ordered for the Royal Australian Navy.

FAIREY AVIATION

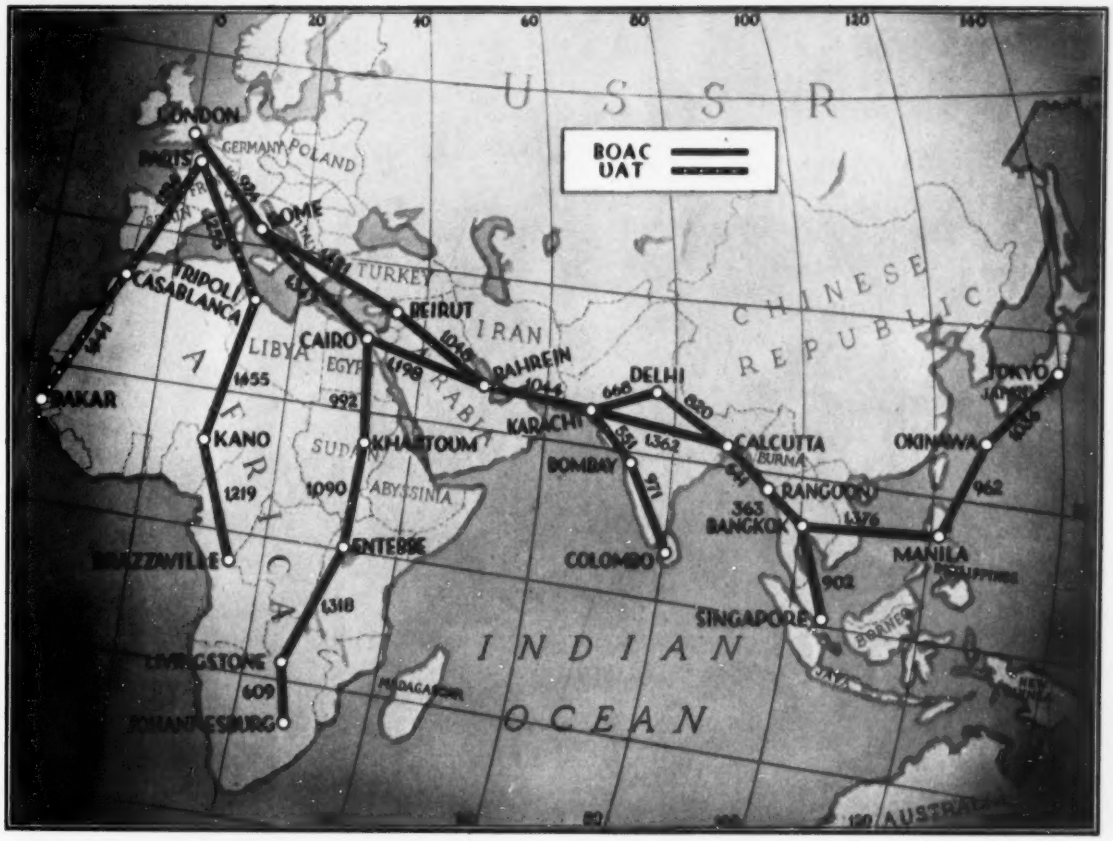
THE FAIREY AVIATION COMPANY LIMITED · HAYES · MIDDLESEX

GHOST

The only jet engine in
air line Service

DE HAVILLAND ENGINES

DH
ENGINES



JET AIR-ROUTES

EXISTING Comet services at present operated by B.O.A.C., and three others recently announced by U.A.T., are depicted on the map above. The tables below provide details of flight times, distances, frequencies of service, and also an indication of fares—these, unlike the times, being the same for first-class services on any other type of airliner.

LONDON—JOHANNESBURG—LONDON

Thrice-weekly service, departing Tuesday, Wednesday and Saturday, returning Monday, Thursday and Friday. Total route distance 6,280 statute miles. Journey time: outward, 21 hr 20 min; return, 21 hr 35 min. Fare (1st class), £175; return, £315.

GMT	LT				LT	GMT
1445	1545	▼dep.	London	arr.	▲0635	0535
1720	1820	arr.	Rome	dep.	0345	0245
1820	1920	dep.		arr.	0245	0145
2145	2345	arr.	Cairo	dep.	2355	2155
2225	0025	dep.		arr.	2315	2115
0115	0315	arr.	Khartoum	dep.	2025	1825
0155	0355	dep.		arr.	1945	1745
0450	0750	arr.	Entebbe	dep.	1740	1440
0605	0905	dep.		arr.	1700	1400
0935	1135	arr.	Liv'stone	dep.	1235	1035
1015	1215	dep.		arr.	1155	0955
1205	1405	▼arr.	Jo'burg	dep.	▲1000	0800

LONDON—COLOMBO—LONDON

Once-weekly service, departing Wednesday, returning Friday. Total route distance 5,959 statute miles. Journey time: outward, 20 hr 35 min; return, 21 hr 40 min. Fare (1st class), £173; return, £311 8s.

GMT	LT				LT	GMT
0930	1030	▼dep.	London	arr.	▲0710	0610
1205	1305	arr.	Rome	dep.	0420	0320
1305	1405	dep.		arr.	0320	0220
1635	1835	arr.	Beirut	dep.	0015	2215
1715	1915	dep.		arr.	2335	2135
2010	0010	arr.	Bahrein	dep.	2225	1825
2050	0050	dep.		arr.	2145	1745
2345	0415	arr.	Karachi	dep.	1915	1445
0025	0455	dep.		arr.	1835	1405
0215	0745	arr.	Bombay	dep.	1745	1215
0315	0845	dep.		arr.	1645	1115
0605	1135	▼arr.	Colombo	dep.	▲1400	0830

LONDON—TOKYO—LONDON

Twice-weekly service, departing Friday (*via* Beirut and Rangoon) and Monday (*via* Cairo and Delhi); returning Sunday (*via* Delhi and Beirut) and Wednesday (*via* Bangkok and Rangoon, and Cairo). Total route distance 10,379 statute miles. Journey time: outward, 36 hr 20 min; return, 39 hr 15 min. Fare (1st class), £260; return, £468.

GMT	LT				LT	GMT
0900	1000	▼dep.	London	arr.	▲0645	0545
1135	1235	arr.	Rome	dep.	0355	0255
1235	1335	dep.		arr.	0255	0155
1600	1800	arr.	Cairo	dep.	0005	2205
1640	1840	dep.		arr.	2305	2105
1945	2345	arr.	Bahrein	dep.	2125	1725
2025	0025	dep.		arr.	2025	1625
2320	0350	arr.	Karachi	dep.	1755	1325
0035	0505	dep.		arr.	1655	1225
0240	0810	arr.	Delhi	dep.	1550	1020
0320	0850	dep		arr.	1510	0940
0540	1110	arr.	Calcutta	dep.	1245	0715
0620	1150	dep.		arr.	1205	0635
—	—		Rangoon	dep.	1105	0435
				arr.	1025	0355
0915	1615	arr.	Bangkok	dep.	0935	0235
0955	1655	dep.		arr.	0855	0155
1345	2145	arr.	Manila	dep.	0620	2220
1445	2245	dep.		arr.	0520	2120
1730	0130	arr.	Okinawa	dep.	0235	1835
1830	0230	dep.		arr.	0135	1735
2120	0620	▼arr.	Tokyo	dep.	▲2330	1430

GMT	LT				LT	GMT
0900	1000	▼dep.	London	arr.	▲0620	0520
1135	1235	arr.	Rome	dep.	0330	0230
1235	1335	dep.		arr.	0230	0130
1605	1805	arr.	Beirut	dep.	2325	2125
1645	1845	dep.		arr.	2225	2025
1940	2340	arr.	Bahrein	dep.	2115	1715
2020	0020	dep.		arr.	2015	1615
2315	0345	arr.	Karachi	dep.	1745	1315
0030	0500	dep.		arr.	1645	1215
—	—		Delhi	dep.	1540	1010
				arr.	1440	0910
0410	0940	arr.	Calcutta	dep.	1215	0645
0450	1020	dep.		arr.	1115	0545
0655	1325	arr.	Rangoon		—	—
0735	1405	dep.				
0855	1555	arr.	Bangkok	dep.	0955	0255
0935	1635	dep.		arr.	0855	0155
1325	2125	arr.	Manila	dep.	0620	2220
1425	2225	dep.		arr.	0520	2120
1710	0110	arr.	Okinawa	dep.	0235	1835
1810	0210	dep.		arr.	0135	1735
2100	0600	▼arr.	Tokyo	dep.	▲2330	1430

LONDON—SINGAPORE—LONDON

Twice-weekly service, departing Sunday (*via* Bangkok) and Thursday (*via* Rangoon); returning Tuesday (*via* Bangkok and Delhi) and Saturday (*via* Bangkok, Rangoon and Delhi). Total route distance 7,831 statute miles. Journey time: outward, 25 hr 30 min; return, 21 hr 40 min. Fare (1st class) £206; return, £370 16s.

GMT	LT				LT	GMT
0800	0900	▼dep.	London	arr.	▲0710	0610
1035	1135	arr.	Rome	dep.	0420	0320
1135	1235	dep.		arr.	0320	0220
1505	1705	arr.	Beirut	dep.	0015	2215
1545	1745	dep.		arr.	2335	2135
1840	2240	arr.	Bahrein	dep.	2225	1825
1920	2320	dep.		arr.	2145	1745
2215	0245	arr.	Karachi	dep.	1915	1445
2255	0325	dep.		arr.	1835	1405
—	—		Delhi	dep.	1730	1200
				arr.	1650	1120
0235	0805	arr.	Calcutta	dep.	1425	0855
0315	0845	dep.		arr.	1345	0815
0610	1310	arr.	Bangkok	dep.	1225	0525
0650	1350	dep.		arr.	1135	0435
0930	1700	arr.	Sing'pore	dep.	0930	0200
or:—						
0520	1150	arr.	Rangoon	dep.	1245	0615
0600	1230	dep.		arr.	1205	0535
—	—		Bangkok	dep.	1115	0415
				arr.	1035	0335
0925	1655	▼arr.	Sing'pore	dep.	▲0830	0100

PARIS—DAKAR—PARIS (U.A.T.)

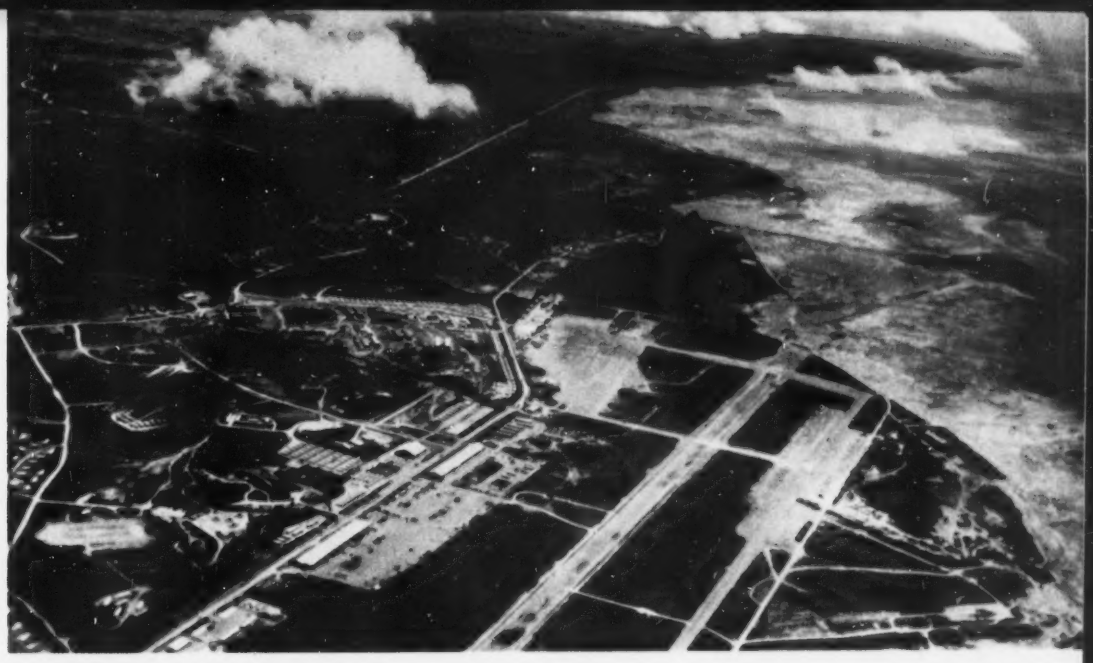
Twice-weekly service, departing Thursday and Sunday; returning Friday and Monday. Total route distance 2,625 st. miles. Journey time, out and return, 7 hr 40 min. Fare: fr. 88,700 (single); fr. 158,760 (return). (Paris—C'blanca—Paris shuttle also operates, Tues. and Sat.)

LT. Thurs.	LT. Sun.	▼			LT. ▲Fri.	LT. Mo.
2315	1530	dep.	Paris	arr.	2240	1700
0115	1730	arr.	C'blanca	dep.	1840	1300
0215	1830	dep.		arr.	1740	1210
0555	2210	▼arr.	Dakar	dep.	▲1400	0830

COMET HIGH

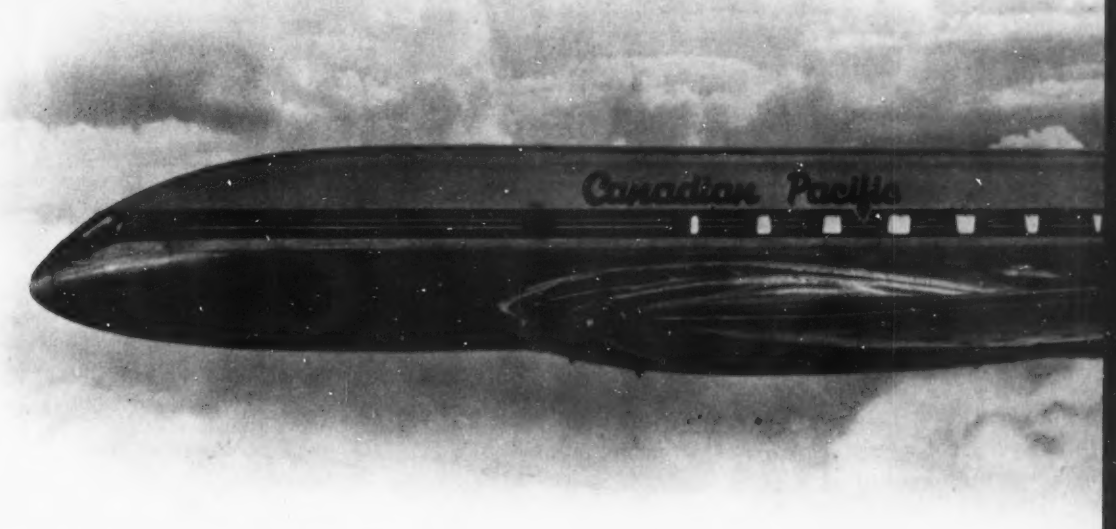
Comet of R.C.A.F. Air Transport Command.

The tight-packed city of Tokyo.

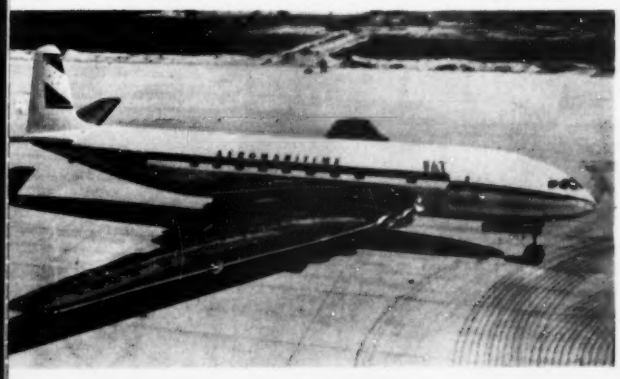


Awe-inspiring cloudscapes, scenic grandeur, and a range of vision hitherto enjoyed by few but the fighter pilot in solitary flight—all these are now offered to the air traveller. From Comets on B.O.A.C.'s Far East routes are seen (left) the River Ganges (Calcutta is nearby, beneath monsoon clouds); and (above) Manila Airport and the Philippine coastline.

WAY



Comet of the French company Union Aeromaritime de Transport.

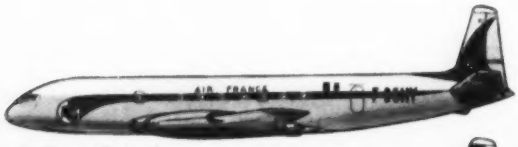


C.P.A.'s choice. (Below) B.O.A.C. Comet takes off for far places.

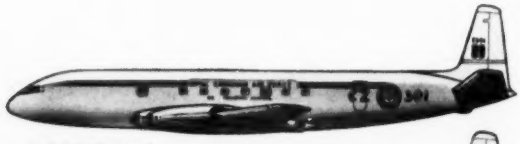
de Havilland Comet 1
Four de Havilland Ghost 50
Span ... ... 115 ft.
Length ... 93 ft.
All-up weight 107,000 lb

COMET LIVERIES

THE subject of the drawing above is a standard Series 1 Comet of B.O.A.C. It is one of nine placed in service last year at an all-up weight of 105,000 lb, now increased to 107,000 lb. The Series 1a aircraft retain the 93ft fuselage, but are cleared for operation at 115,000 lb. The numbers ordered were: U.A.T., 3; C.P.A., 2; R.C.A.F., 2; and Air France, 3. The Series 2 Avon-powered Comets, now on the line, have a 96ft 1in fuselage and an all-up weight of 120,000 lb. Orders are: B.O.A.C., 12; B.C.P.A., 3; Japan Air Lines, 2; L.A.V., 3; M.o.S., 1; and Panair do Brasil, 4; Air France, C.P.A. and U.A.T. have options. The Series 3, fitted with more powerful R-R. Avon RA.16s, will have a 111ft fuselage and a certificated weight of 145,000 lb. Orders are: M.o.S., 1; and P.A.W.A., 3; options are held by: B.O.A.C., 10; P.A.W.A., 7; and Panair do Brasil, 2; "intention to purchase": Air India International, 3; G. F. Luftverkehrsbedarf, unstated. Many other orders are being negotiated.



Air France Series 1a.



R.C.A.F. Series 1a.

U.A.T. Series 1a.

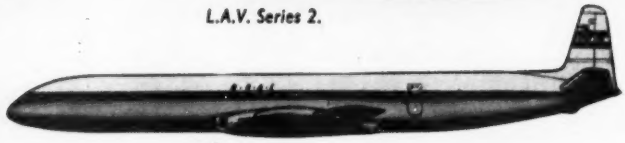
C.P.A. Series 1a.

P.A.B. Series 2.

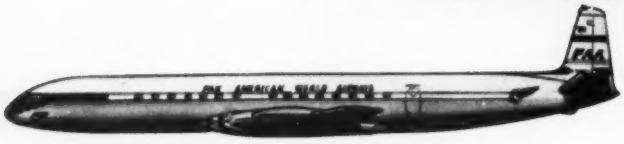
J.A.L. Series 2.

B.C.P.A. Series 2.

L.A.V. Series 2.



B.O.A.C. Series 3.



P.A.W.A. Series 3.

Air India Series 3.

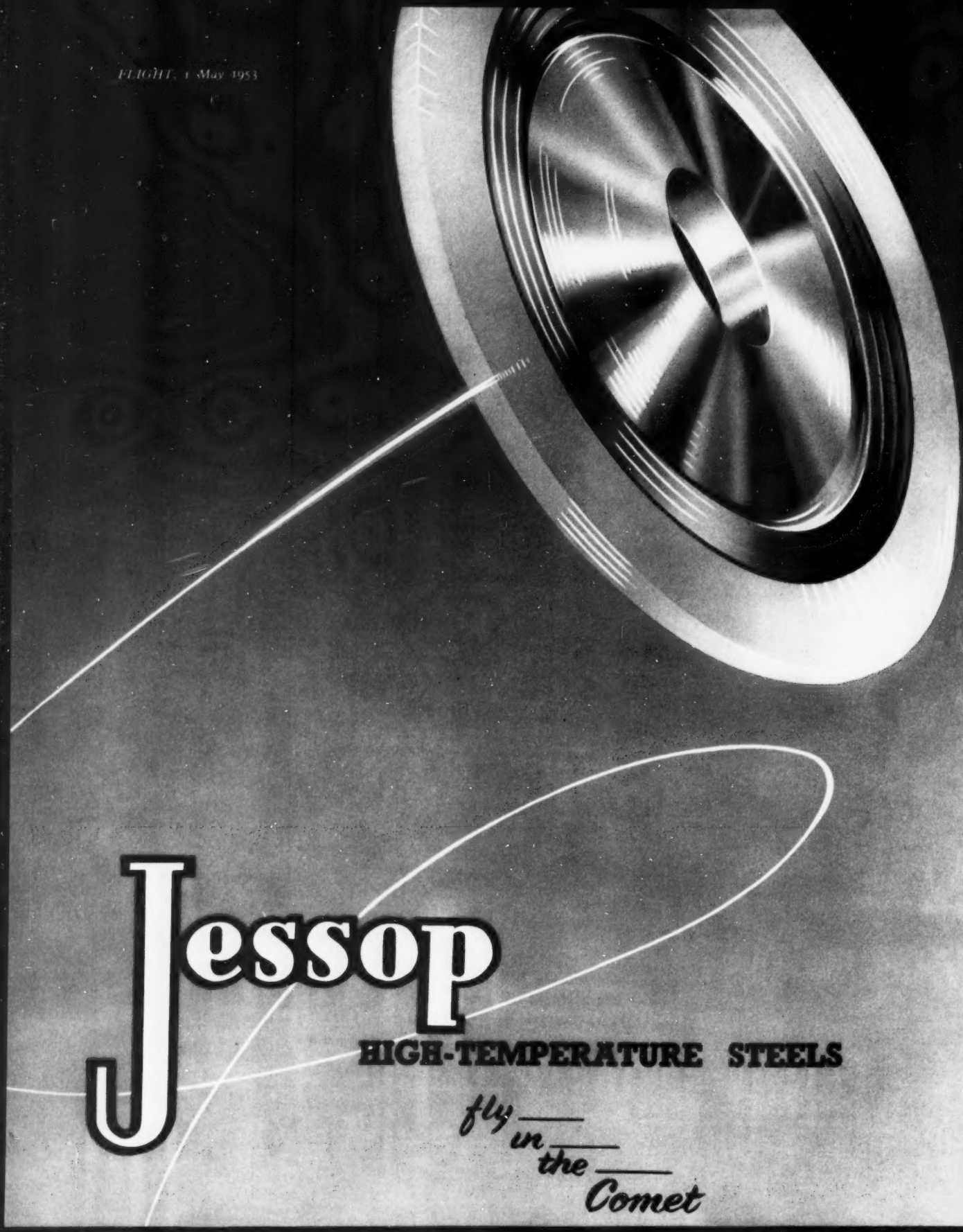
"Flight" copyright drawings by Barry Jones

In service with the Royal Navy
The Percival Sea Prince fitted
with Alvis Leonides engines

ALVIS

LEONIDES

ALVIS LIMITED, COVENTRY, ENGLAND



Jessop

HIGH-TEMPERATURE STEELS

fly in the Comet

WILLIAM JESSOP & SONS LTD

STEELMAKERS SHEFFIELD

COMET ENGINEERING

The Performance of Airframe, Engines and Equipment in Operational Service

THAT the proverbial pudding is proved in the dining-room rather than in the kitchen is only too well known to both constructors and operators of airliners, for it is generally agreed that—no matter how thoroughly a transport may be proven during its development flying—the only comprehensive test is scheduled service.

As the de Havilland Comet I has today completed its first year of such service it is appropriate to record its behaviour during this period. In particular, it is instructive to examine the performance of those items which normally give most trouble on a new piston-engined airliner—insofar as this is possible for, by the very nature of the Comet, many of the most troublesome are absent.

Although we believe that such a survey stands well on its own merits, a further reason for its appearance at this time is that it will help to keep the record straight, in the face of a number of overseas critics who, sometimes with the best intentions, have doubted that an aircraft such as the Comet could be operated by a normal airline at all. Perhaps B.O.A.C. is not a normal airline; they are certainly more pioneering than most, quite apart from any questions of "unlimited financial backing." But they have shown that the Comet I has, in its first year, required less maintenance and given less trouble than any other four-engined airliner of recent years in a comparable stage of development. When one considers the extraordinary range of conditions through which the Comet travels on every flight this fact is truly remarkable.

One of the major threats to serviceability has been the extreme variation in temperature encountered. With B.O.A.C., and now with U.A.T., the Comet I has been regularly flying from some of the hottest airfields in the world. At the other end of the scale, the ambient temperature at cruising altitude has fallen to as low as −73 deg C. It is by no means unusual to find frost beneath the wing of a Comet parked in tropical sunshine, the metal skin being kept cold by the kerosine within. The Comet had, of course, met such temperature-changes long before it entered B.O.A.C. service, but a new range of alloys, rubbers and plastics had to be prepared to meet these conditions, and the majority were quite new to civil aviation.

The choice of a cabin-pressure differential as high as 8¼ lb/sq in was another step into the unknown, and the de Havilland company have, since 1947, been quite well aware of the consequences of structure- or window-failure at such a pressure. High air-speed posed another set of problems, and yet another was the fact that no prior gas-turbine-powered aircraft had ever been flown so intensively as are civil airliners throughout many years of service.

But B.O.A.C. were prepared to stake their reputation on the Comet and put it to work as a normal airline vehicle for fare-paying passengers, demanding little special dispensation at its ports of call, either in ground handling or in air-traffic control. Their confidence was more than justified, as the following account will show. For convenience, the various parts of the aircraft have been treated under separate sub-headings.

Structure.—The Comet airframe is far more conventional than might have been the case, and it presents few problems either in manufacture or in maintenance. The most novel feature is the extent to which Redux bonding has been adopted. At the time of the initial design of the Comet, the de Havilland company already had enough experience of the process to be confident that it could be used, but they were exceedingly bold in adopting it not only to attach minor stringers and stiffeners but also to make primary airframe joints, such as those between spar booms and webs, and between large fuselage stringers and window frames and the skin. The Reduxing of large areas of double-curvature was another innovation.

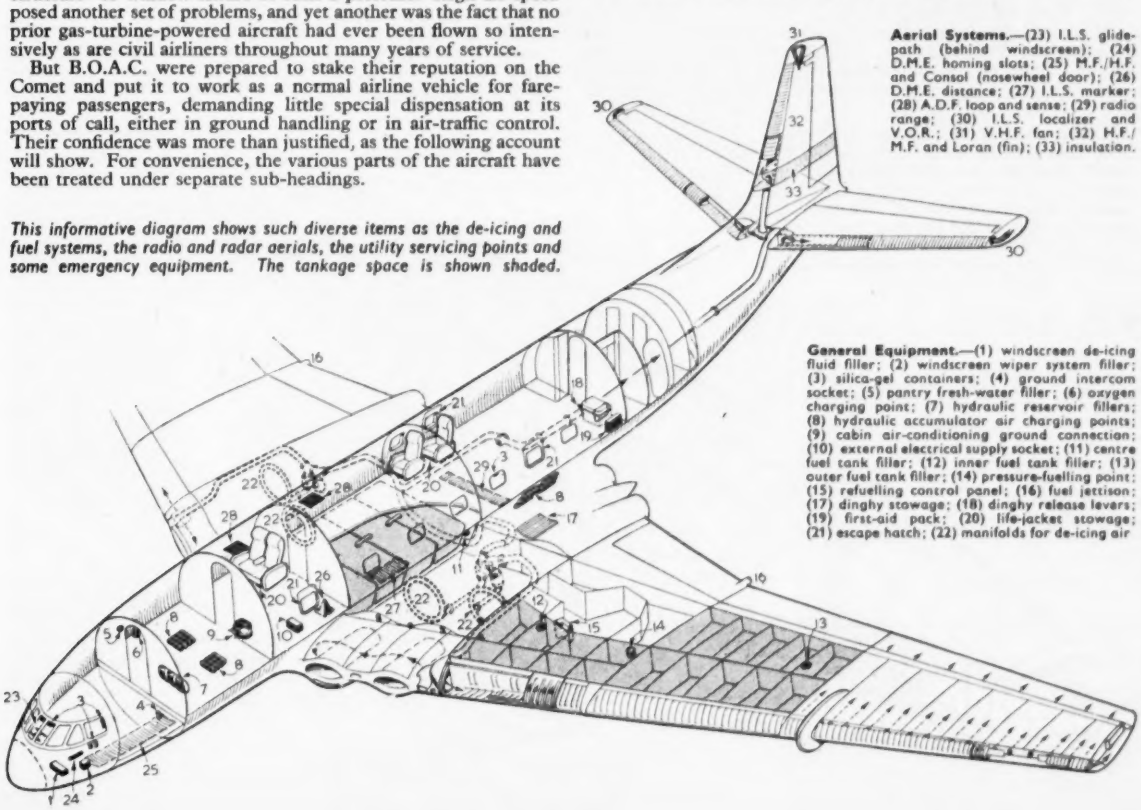
Quite apart from the reduction in structure-weight which the process allows, the Reduxed structure has proved simpler and cheaper to manufacture, has made possible a smoother exterior and has greatly eased pressurization and tank-sealing problems. During the past year, B.O.A.C. have had only one Redux failure on the Comet, and that of the most minor character. It occurred in one of the integral wing tanks and could not have had serious consequences. A repair was quickly effected and has proved satisfactory.

In an aircraft of this nature the maintenance of a smooth and regular exterior skin is obviously highly desirable. B.O.A.C. did, in fact, issue rope-soled shoes to Comet Fleet servicing personnel, but these have largely been discarded in favour of protective mats. In spite of the large area of the wing, there are few unsupported parts of skin and the skin is itself in quite heavy gauge. At one time it was felt that loose panels might be damaged while away from the aircraft, but no unusual precautions have been required to guard against this happening.

One part of the airframe that has suffered damage has been the flaps. These large surfaces are liable to superficial damage from stones kicked up by the bogie landing gear and, to a greater degree, to serious distortion by flood water. Khartoum—of all places—suffered severely from flooding last year, and Comet services sometimes had to put down and take-off from a solid sheet of water. But the aircraft remained serviceable and the flaps are by no means ready for replacement yet.

During take-off the tail-bumper should not be allowed to touch the runway, and the possibility of pilot-error is being countered by revised technique. No modification to the aircraft has been required.

Much has been made in the United States of the dire conse-



This informative diagram shows such diverse items as the de-icing and fuel systems, the radio and radar aerials, the utility servicing points and some emergency equipment. The tankage space is shown shaded.

Aerial Systems.—(23) I.L.S. glide-path (behind windscreen); (24) D.M.E. homing slots; (25) M.F./H.F. and Consol (nosewheel door); (26) D.M.E. distance; (27) I.L.S. marker; (28) A.D.F. loop and sense; (29) radio range; (30) I.L.S. localizer and V.O.R.; (31) V.H.F. fan; (32) H.F./M.F. and Loran (fin); (33) insulation.

General Equipment.—(1) windscreen de-icing fluid filler; (2) windscreen wiper system filler; (3) silica-gel containers; (4) ground intercom socket; (5) pantry fresh-water filler; (6) oxygen charging point; (7) hydraulic reservoir fillers; (8) hydraulic accumulator air charging points; (9) cabin air-conditioning ground connection; (10) external electrical supply socket; (11) centre fuel tank filler; (12) inner fuel tank filler; (13) outer fuel tank filler; (14) pressure-fuelling point; (15) refuelling control panel; (16) fuel jettison; (17) dinghy stowage; (18) dinghy release levers; (19) first-aid pack; (20) life-jacket stowage; (21) escape hatch; (22) manifolds for de-icing air

COMET ENGINEERING . . .

quences of windows blowing out at 40,000ft. The de Havilland company have approached the undisputed problem by treating windows as though they were part of the basic airframe, and stressing them accordingly. In fact, not only have Comet windows been tested to 100 lb/sq in, but another has been pressurized to 8¼ lb/sq in daily for several years and cleaned regularly with scratch-remover, as are windows in service. The Air Registration Board is quoted as saying that explosive decompression at 40,000ft "shouldn't happen any oftener than a wing falling off."

A related subject which is also causing transatlantic concern is the provision of doors in pressure cabins The Comet has two main doors, one aft on the port side for passengers and one on the starboard side of the forward fuselage for the crew. The passenger door hinges inwards in a straightforward manner, while the crew door lifts away from the wall and slides upwards around the roof in runners. Both, therefore, open inwards. The American Civil Aeronautics Administration, on the other hand, are currently favouring outward-opening doors—the assumption being that an inward-opening door constitutes a barrier to rapid passenger-escape after a crash. This proposal seems to suggest a lack of experience on the part of the organization concerned, for quite apart from considerations of in-flight safety, it appears very unlikely that any economic jet airliner could have such doors—such is the weight-penalty involved.

Underneath the Comet fuselage are other doors: two, opening outwards, cover the unpressurized nosewheel bay, while inward-opening hatches seal the equipment bay and the rear freight hold. The two latter are opened from the outside only; like the main doors above floor level they are pressure-sealed, and lock without slamming. No leakage has been noticed with any door, neither has any locking trouble occurred.

De Havillands decided, early in the design, to use single panes for the pilots' direct-vision panels and for the small, circular windows in the entrance doors. Although the C.A.A. disagrees with such practice, D.H. feeling is that—provided the windows are properly designed and stressed—two panes are no better than one. The rest of the Comet windows are double-thickness units, the layers being (from the inside): a thin, unstressed sheet of Perspex capable of accommodating the great temperature-difference between the interior and ambient air without great internal stress; a gap supplied with dry air from a desiccator; and an outer, thick sheet of Perspex carrying the pressure-difference. An exception to this rule is made in the case of the windscreen panels directly in front of the pilots; these have the thick, pressure-resisting pane on the inside and a splinterproof sheet of laminated glass on the outside.

Four of the passenger windows form emergency exits. They can be released from either inside or outside the aircraft and, since they open inwards, inadvertent release in the air is impossible. These exits are above the wing.

No modifications have been necessary to the airframe as a result of severe treatment in service. The structure is immensely strong and has shown no signs of tiredness, in spite of continued small-amplitude, high-frequency vibration and, sometimes, "cobble-stone" acceleration-loading in clear-air gusts. Another point is that there has been no measurable performance-deterioration arising from skin wrinkling.

Power Plant.—There is no doubt that it was a wise move when the decision was taken—jointly by de Havilland and B.O.A.C.—to put Ghost-Comets into service at the earliest possible date, and not to wait for the civil Avon. By so doing, at least 18 valuable months of experience are being accumulated, and the more efficient axial-engined Comets will thereby benefit.

This is not to suggest that the Ghost is proving an inefficient transport power-plant. Far from it; the de Havilland Engine Company have shown that the turbojet can be developed for airline service until it requires fewer man-hours in maintenance than the average equivalent piston engine.

Only one major fault has occurred: during the first few months of 1952 B.O.A.C. experienced a run of cracked compressor impellers, which necessitated immediate rectification. The trouble was quickly traced to high-frequency fatigue and a cure was effected by slightly cropping the impellers which did not affect the engine performance. A failed engine was then subjected to a 17-hour simulated Johannesburg-London flight, without trouble. Incidentally, none of these compressor failures was noticed by the crew at the time of occurrence—which meant that the aircraft was, in most cases, at the London maintenance base when the trouble was discovered.

It is particularly important to phase-in inspections of the combustion chambers and flame tubes with the main overhauls of the engines. "Can" inspections are, although of minor consequence in themselves, annoying in that they demand removal of the engine from the airframe.

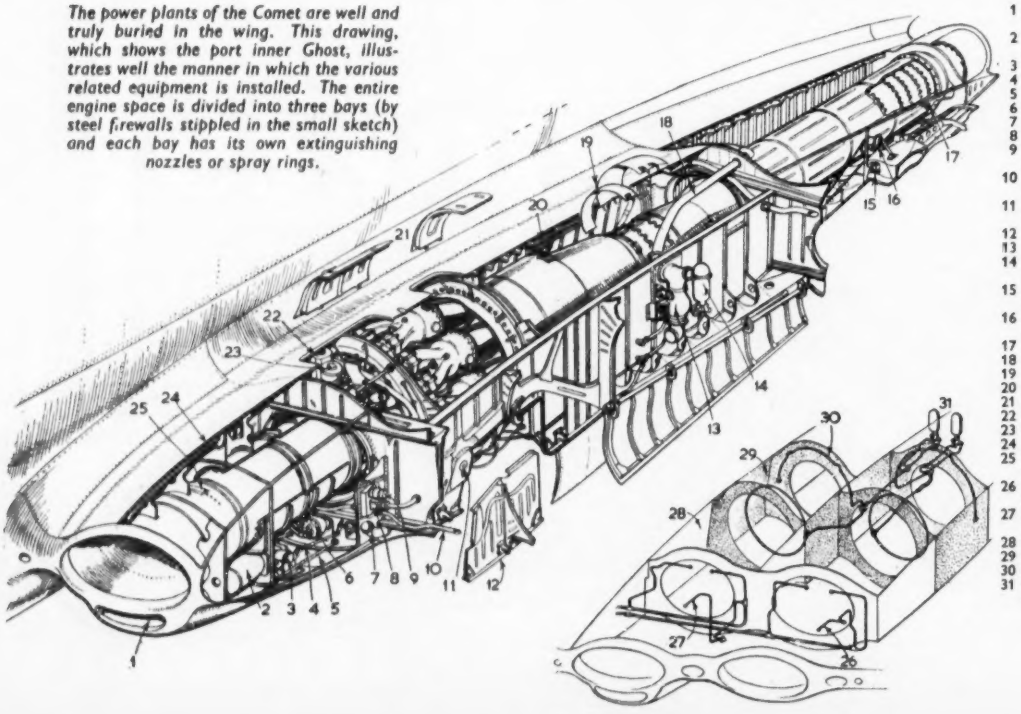
The initial engine-overhaul experience was obtained with G-ALZK, the Ministry of Supply Comet 1. At first, main overhauls were fixed at 250-hr intervals, but B.O.A.C. started scheduled operations with a 375-hr period. This was not a particularly good schedule, as the can inspections were set at 150-hr intervals—a figure which does not divide neatly into 375. As a consequence, A.R.B. approval was obtained for a 450-hour cycle on the main overhauls, and this has been the arrangement used during most of the Comet's first year of work.

At the present time, B.O.A.C. have eight Ghosts running to a 600-hr main-overhaul cycle, which allows three can-inspections between each overhaul. Additionally, Joseph Lucas have developed a new flame-tube—the Mk V—which B.O.A.C. expect to adopt, initially on a 200-hr basis and later with inspections every 300 hr. Very soon, therefore, the engine cycle will be: 300 hr, can inspection; 600 hr, overhaul; 900 hr, can inspection; 1,200 hr, overhaul; and so on.

Admittedly this may appear to entail more work than does the upkeep of well-established piston engines, with overhaul periods of the order of 1,000 hr, but it should be appreciated that the actual work involved in carrying out a Ghost overhaul is considerably less. Some figures will bear out this contention.

With the Stratocruiser, some 40 man-hours are needed to change an engine, and even when removed from the airframe the Wasp Major is a complex power plant requiring much breaking-down and building-up. But Comet engine changes at base run

The power plants of the Comet are well and truly buried in the wing. This drawing, which shows the port inner Ghost, illustrates well the manner in which the various related equipment is installed. The entire engine space is divided into three bays (by steel firewalls stippled in the small sketch) and each bay has its own extinguishing nozzles or spray rings.



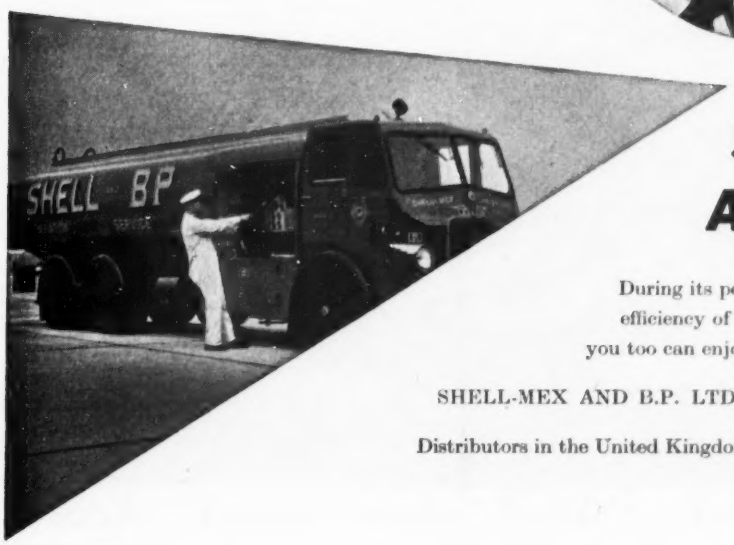
1 Cabin-air heat-exchanger intake.
2 Cabin-air heat exchanger intake duct.
3 Hot air to heat exchanger.
4 Shutter control.
5 Detachable bottom panel.
6 Hydraulic pump.
7 Air supply duct.
8 Low-pressure fuel cock.
9 Fuel flowmeter transmitter.
10 Fuel pipe to outboard engine.
11 Engine trunnion mounting location.
12 Access panel in engine rib.
13 De-icing air valves.
14 Methyl bromide extinguisher bottle.
15 Inner (split) flap centre hinge.
16 Flap-operating cable wheel and linkage.
17 Tailpipe supporting roller.
18 De-icing air duct.
19 Detachable lagging.
20 Tailcone sling.
21 Access panels.
22 Alternator.
23 Starter.
24 De-icing duct.
25 Cooling air from alternators and rectifiers.
26 De-icing mixing chamber spray.
27 Wing equipment-bay spray.
28 Fire zone No. 1.
29 Fire zone No. 2.
30 Engine spray rings.
31 Methyl bromide extinguisher bottles.

Many happy returns!

The de Havilland Comet. The first jet airliner ever to enter scheduled service—on the 6,000 mile London-Johannesburg B.O.A.C. route. In service less than three years after its first test flight. Broke many point-to-point speed records during experimental period. Four de Havilland Ghost engines ; span 115′, length 93′.

the pilot

John Cunningham, D.S.O. and 2 bars, O.B.E., D.F.C. and bar, joined de Havilland when 18 years old in 1935. A notable career in R.A.F. from 1940 to 1945 included commanding 85 Squadron (Mosquitoes) 1943-44, and Group Captain Ops. at H.Q. 11 Group. Later service over battle areas after D-day, and against flying bombs. Has worked on the Comet as Chief Test Pilot since the first plywood mock-up days, and has flown hundreds of hours in Comets. Says he has " had very good service from Shell and BP ".



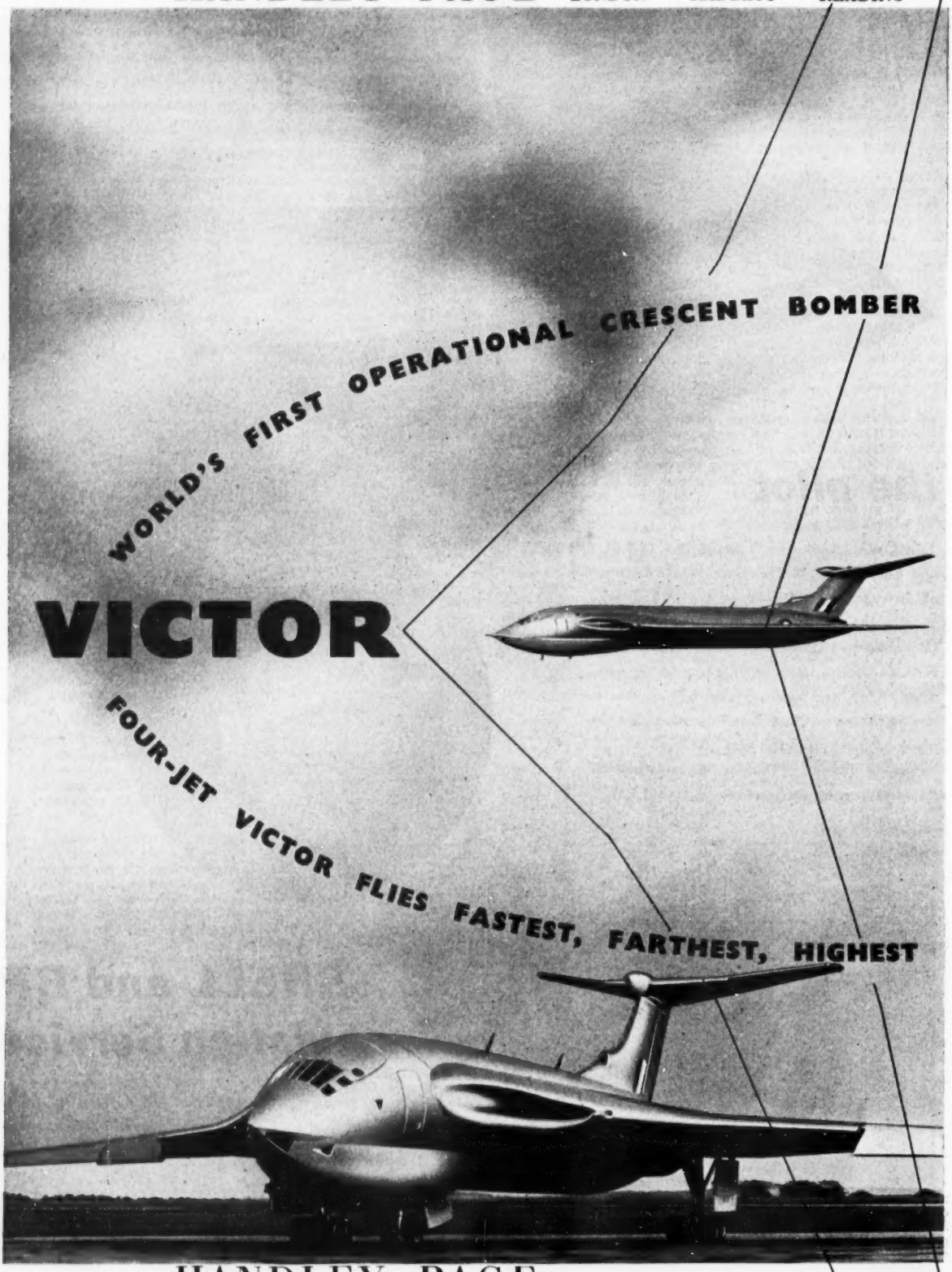
SHELL and BP Aviation Service

During its period of test the Comet relied upon the skilled efficiency of Shell and BP Aviation Service—the sort that you too can enjoy at any of the major aerodromes in Britain.

SHELL-MEX AND B.P. LTD., Shell-Mex House, Strand, London, W.C.2

Distributors in the United Kingdom for the Shell and Anglo-Iranian Oil Groups

HANDLEY PAGE LONDON · RADLETT · READING



HANDLEY PAGE LONDON · RADLETT · READING

COMET ENGINEERING . . .

to about 12 man-hours (three men for four hours) and the civil Ghost 50 is a compact unit requiring no further disassembly once it is removed from the aircraft.

The installation of the Ghost is shown in the *Flight* drawing on p. 552, which shows the port inner engine. The engine is carried by two simple trunnion bearings, incorporating Metalastik bushes to prevent the transmission of much high-frequency noise to the airframe. At the top is a single steadying tie-rod; all three pick-up points are secured by single bolts, and all the pipelines, cables and control runs are fitted with quick-release joints. The main air-intake duct is attached to the engine by a single toggle fastener; the jet-pipe—a lengthy unit owing to the considerable wing-chord—is secured by four simple clamps. When the latter are released, the pipe may be slid out to the rear on runners. At present, B.O.A.C. use a mobile crane for removing and replacing the Ghosts, which weigh slightly less than a ton apiece. The engine can be removed downwards once the trunnion bolts have been undone and the disconnections made, there being no need for particularly accurate positioning. A tensiometer sling has, however, been found necessary, to guard against overloading the lifting gear or damaging the engine.

Apart from scheduled inspections, the Ghosts are given daily and pre-flight inspections; but these are quite minor and take one man about twenty and ten minutes respectively. A ground run is only carried out after 35 hours flying or if the aircraft has been out of use for 72 hours, and it should be noted that a Ghost—any turbojet, for that matter—may be run-up to full power directly from cold. The entire engine bay can be reached from the ground, and B.O.A.C. have not purchased any special trestling or staging for Ghost overhauls.

One of the most heartening features of the Ghost's behaviour has been the manner in which, time after time, a snag has given no evidence of its presence until final detection at London Airport. This should not be taken as implying that the Comets are cruised happily with a sea of troubles on board; rather, that the troubles have been of a minor nature of a kind that could be rectified when the Comet has returned to the maintenance base. As a result, that scourge of efficient airline operation, the non-scheduled overhaul, has very rarely been necessary.

The actual figures are noteworthy, and may be taken as indicative of the sort of performance to be expected as the Ghost and its axial successors are further developed. The failure-rate per thousand flying hours has been 0.8, counting non-productive flying, crew-training and route-proving. The current rate in normal service is 0.49 unscheduled engine changes per thousand hours which, as A. Cdre. F. R. Banks recently pointed out, may be compared with the figure of 0.6 established in service by two of the most highly developed radial piston-engines.

The Ghost is, of course, singularly robust and so simple that there is not very much that can go wrong. By far the major proportion of failures have occurred in the ancillaries. The alternator cooling-fan for example (necessary on the ground only), runs at up to 20,000 r.p.m. and the ball bearings originally fitted to its shaft did not stand up to the operating conditions. The solution was a switch to Vandervell thin-wall bearings, lubricated by an oil film, which has proved quite satisfactory.

Relighting is not a feature of normal operations, and even low-altitude stacking is at present done on four engines. But incorrect pilot drill with the pump-isolation switches can put an engine out and the easy relight of the Ghost is considered an asset. With the high-energy ignition system, now used in place of the original torch igniters, relighting is quite straightforward even above 25,000ft. And there is no doubt that later engines will better this performance.

Following on from this it may be said that the Ghost turbine/compressor unit runs in ball, roller and safety bearings, the latter bringing the engine to rest if all the others fail. If complete engine failure were to occur in flight the engine would, unless structural damage prevented it, continue to windmill at about 1,000 r.p.m. under the influence of ram air. Neither B.O.A.C. nor de Havilland consider there is any case for a means of stopping the engine dead in the air, although the C.A.A. are reported to be considering making this requirement mandatory.

Time-expired Ghosts are sent to the D.H. test-beds and, in every case, they have been run up to full thrust. The only deterioration in performance has been a very slight rise in jet-pipe temperature and specific fuel consumption. As regards performance deterioration in flight B.O.A.C. do not employ any form of installed thrustmeter—as favoured by the C.A.A.—nor do they consider there is any need for such a device. Any loss of power, or malfunctioning, of a Ghost can be detected at once.

Before leaving consideration of the Comet power plant, one obvious question to be answered is "do de Havilland and B.O.A.C. think that their choice of buried (as opposed to podded) engines was correct?" Both partners answer an unqualified "yes"; later Comets will continue to employ installations of this type.

Landing Gear.—The D.H. designed undercarriage has given outstanding service and has required no modification whatever. Maintenance of the gear has posed no problems, in spite of the fact that it is the first time an airline has employed a bogie undercarriage, or units built around large, light-alloy forgings. Inherent in bogie-equipped aircraft is a limit on the turning radius, but this has not led to damage or tyre-scrubbing, neither has it impaired the Comet's ground mobility.

The main bogies have stood up well to severe treatment, including landings with considerable drift on to indifferent runways. Certainly, the bogies ride better than equivalent single-wheel units (as were fitted to two Comet 1 prototypes) and they have also permitted operation from much poorer surfaces. Another advantage has been the ease with which the small tyres and wheels can be manhandled. The mainwheel tyres are Dunlop 35.00 x 17 size and they operate at 115 lb/sq in at 105,000 lb aircraft all-up weight.

Tyre behaviour has been fully up to expectations, and no particular trouble has been experienced from slamming of the front bogie-wheels on to the runway. The present tyre-life works out to roughly 100 landings for the mainwheels and between 100 and 200 for the nosewheels. The latter wheels are unbraked and are splined to a common shaft to eliminate shimmy.

This performance is underlined by the airfields through which the Comets fly regularly. Many Comet ports of call—including London—are still partly under construction and contractors' lorries have a habit of strewing runways with small bits and pieces. The Comets, with their eight ribbed mainwheel tyres, suffered by picking up such paraphernalia in the tyre ribs. This, and the severe tension across the tread, has now led to the introduction of a new Dunlop "dimpled" tyre which, having no ribs, collects no damaging material; also, it is broader, and stronger under side-load.

The power-steered nose unit has also given fine service. A steerable nosewheel is essential on such an aircraft for it is not the practice to use differential engine power for ground manœuvring, neither would this have much effect.

The difficulty of bringing jet transports to a halt after landing is one of the current "anti-jet" views being voiced in the United States. It is true that the Comet has not had to contend with icy runways—except at London, where there is plenty of room. But the landing has never been a critical factor in any of B.O.A.C.'s operations with the aircraft, and this includes services through airfields with runways of normal length, sometimes in conjunction with very adverse combinations of altitude, ground temperature and gradient.

The brakes are duplicated Dunlop disc units, and B.O.A.C. praise them highly. Last year, B.O.A.C. decided to fit discs of increased thickness in order to comply with the requirements of the worst accelerate-stop case without overheating. An unexpected windfall is the fact that these discs can, after an undetermined but considerable number of landings, be machined smooth and replated; this can also be done a second time, trebling the effective life of the units. When it is recalled that there are 16 brake discs to each Comet, this is seen as an appreciable saving.

Dunlop's Maxaret anti-skid equipment is to be fitted to the B.O.A.C. Comet 2s, and the device may be fitted as a retrospective modification to the Series 1s.

Hydraulics.—A study of the Comet manuals reveals the unusual extent of the hydraulic system, and it also leaves one slightly dazzled, for there are five separate circuits and each is allotted a distinctive colour. The systems which are of de Havilland design are:

(1) *Green* system, serving landing-gear retraction, nosewheel steering, wheel- and air-brakes, flaps, flying-control secondary servos and windscreen wipers. The green circuit is fed by a hydraulic pump on each outer engine.

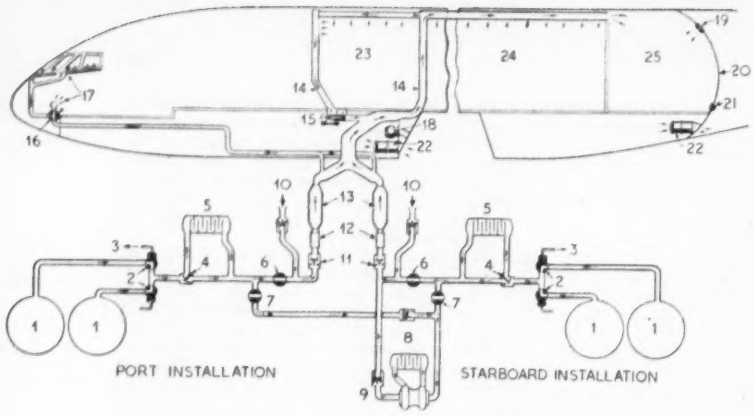
(2) *Blue* system, charged with the vital task of actuating the flying-control primary servo units. Blue fluid cannot be introduced into any other system, and vice versa. The circuit is connected with a pump on each inner engine.

(3) *Yellow* (emergency) system, which takes over the flying-control secondary servo units in the event of failure of both blue and green circuits. Power is supplied by an electrically driven pump, and the yellow service can also be used for ground-testing the flying controls when no other power is available.

(4) *Red* (stand-by) system, which can be used for emergency lowering of the undercarriage, and operation of flaps, wheel-brakes and steering. Again, power is supplied from an individual electrically driven pump and the red supply can be passed through all normal systems, other than the flying-control primary servos, for ground testing.

(5) *Broken-red* (manual) system, the hand pump of which can be used to energize the emergency down-lines of the undercarriage only.

Each system is labelled in its own distinctive colour, and this has made servicing much more rapid and straightforward than would otherwise have been the case. The principal supplier of



Although it looks complicated at first sight, the Comet air-conditioning and pressurizing system derives heated, compressed air from the main engine compressors. Separate blowers and heaters are therefore unnecessary.

(1) Engines; (2) shut-off valves; (3) spill to atmosphere; (4) temperature control-valves; (5) primary heat-exchangers; (6) mass-flow valves; (7) refrigeration valves; (8) secondary heat-exchanger; (9) cold-air unit; (10) auxiliary cabin-ventilation ram-air intakes; (11) non-return valves; (12) metering ducts; (13) humidifiers; (14) cabin-bulkhead ducts; (15) re-circulating fan; (16) warm-air valve; (17) warm-air distribution to pilots' feet and windscreen; (18) safety valve; (19) inward relief-valve; (20) pressure dome; (21) ground-test point; (22) main discharge-valves; (23) forward cabin; (24) main cabin; (25) washrooms and toilets.

COMET ENGINEERING . . .

hydraulic components is Lockheed (Automotive Products) and the normal working pressure is 2,500 lb/sq in. Change-over from, say, blue to green for flying-control power is assisted by accumulators, which smooth out the operation of the boosters through separate pressure-lines. Other accumulators are provided which make the circuits operate on a constant-pressure basis.

Duplication is an unavoidable evil in so extensive a hydraulic system as that of the Comet, particularly since control of the aircraft by direct manual linkage is not practicable. The resulting installation is as foolproof as any yet designed and, as long as the Comet has enough power to fly, at least one hydraulic circuit will be available, with battery-powered circuits in reserve.

It is virtually impossible to eliminate "snags" from an extensive new hydraulic network during the pre-service test period, although every effort was made to this end in the case of the Comet. In the event, seal failures and minor leaks were at one time responsible for 40 per cent of all Comet un-scheduled delays (trouble affecting a service departure-time) but the first year of operations comes to a close with the figure at rather less than 2 per cent. Taking everything into account, this is an excellent result. One of the most rewarding modifications was to make the circuits self-air-bleeding, through the header tanks.

The only fluid currently approved for the Comet hydraulic system is Lockheed 22, the well-known castor-base oil. But non-inflammable fluids are now available and the furthest-developed of the British "non-flams," Esso E.E.L.6, is being introduced to the Comet on an experimental basis. At present E.E.L.6 is being used on the hydraulic motors driving the first officer's windscreen wipers—this being a typical "harmless" service—and, if it proves successful, may become the new standard fluid.

Flying Controls.—Something has been said of the Comet control-circuits under the previous sub-heading, and the flaps and brakes have already been discussed.

The general opinion in B.O.A.C. of the Servodynes used in the flying-control circuits is that they are smooth in operation and, as they must be, completely trustworthy. Since the only force exerted by the pilot is that needed to displace spring-struts from their trimmed neutral position, some pilots have found some lack of "feel" upon conversion to the Comet. But correct judgment has always come quickly.

The ailerons are handled quite normally, although the force exerted by the pilot does not increase in direct ratio to departure from the trimmed position. The rudder-pedal force is proportional to deflection applied, but this control is not used at all except during take-off, landing and assymmetric flight. By far the most important control is the elevator, as in all high-speed aircraft. Stick-force does vary with elevator deflection, but this is of secondary importance, for virtually all longitudinal control is carried out with the trimmers.

Trimming controls consist of biasing spring-struts actuated by screw-threads from the central cockpit pedestal. Their effect is very slightly delayed, since they do not act on the surface directly, but trimming is positive and sensitive. The tabs visible on the ailerons and elevators are self-contained balance tabs.

The elevators of any high-speed aircraft require very careful design, for they undergo a much harder life than does the remainder of the structure. In the Comet there was a little trouble with elevator skin-cracking, but a rapid modification has completely cured this tendency.

The hydraulic side of the flying controls has given no real trouble, trivial leaks being the only factor requiring rectification. As already described, complete duplication (green and blue) is always in use, with the yellow circuit available in emergency. Each Servodyne is a paired unit, the halves being bolted back-to-back. Only one half is energized at one time (normally the blue) the other being a passive follower.

The final point to be mentioned in connection with the control system is the fact that the virtually foolproof hydraulic installation is considered ample justification for dispensing with any manual linkage. The C.A.A. are pressing for the adoption of pilot-operated tabs for use in emergencies. Although it must be acknowledged that the Britannia does not employ powered controls at all, and uses a very efficient manual-tab arrangement, neither D.H. nor B.O.A.C. feel there can be any justifiable criticism of the Comet on this subject.

Air Conditioning.—Here the Comet enjoys a very great advantage over all other pressurized airliners: the cabin air is provided, already pressurized and heated, by the main engine compressors. This has permitted the elimination of the cabin blowers, heaters and all their associated drives and fuel lines.

Each Ghost compressor is tapped at its periphery; the basic circuit is shown in the drawing on this page. The normal cabin pressure is 8¼ lb/sq in, the safety valves opening at 8½ lb/sq in. It will be seen that an adequate, independent supply is available from either wing and, if necessary, any engine can be taken out of circuit. The percentage of the total mass-flow bled for the cabin is always less than unity. The engine has automatic control to prevent undue rise in jet-pipe temperature during this delivery.

The air is delivered at over 200 deg C and the Saunders valves developed to control the flow have proved very reliable. The main components are by Normalair, and have worked well. Some trouble has been experienced with the automatic mass-flow control and the actuators of the mass-flow valves have, on occasion, been overloaded when the vaives tended to stick. Neither trouble is now experienced in any marked degree. The good behaviour of the system is particularly noteworthy when it is appreciated that many of the units are outside the pressure hull and get extremely cold in flight.

It was at one time feared that contamination of the compressor air within the engine might prove a problem, but this has fortunately proved unfounded. In the few cases where an engine oil leak has occurred, the affected engine has immediately been shut off from the air supply. Air is available from the engines for ground-test purposes but for proof-loading an external supply is needed. The Godfrey and M.L. ground-conditioning trolleys have proved quite capable of serving the Comets at all their stopping places.

De-icing.—The main engine compressor is again used as a ready source of heated, compressed air. The delivery is piped along the leading edges of the wings and tail unit and has given little trouble. Windscreen de-icing is accomplished by the usual alcohol sprays, assisted by the dry-air sandwiched between the two layers of transparency. The rear bearing of each Ghost is cooled by an oil flow which is then piped round to de-ice the front of the engine—the front bearing in particular.

Altogether, no real de-icing troubles have been met, apart from those discussed under the next sub-heading. Such is the reward for cruising at 40,000ft and above, for icing is never met except during climb and descent (for very brief periods) and, to a greater degree, during medium-altitude stacking. An inspection lamp is fitted to illuminate the starboard leading edge and air intakes at night.

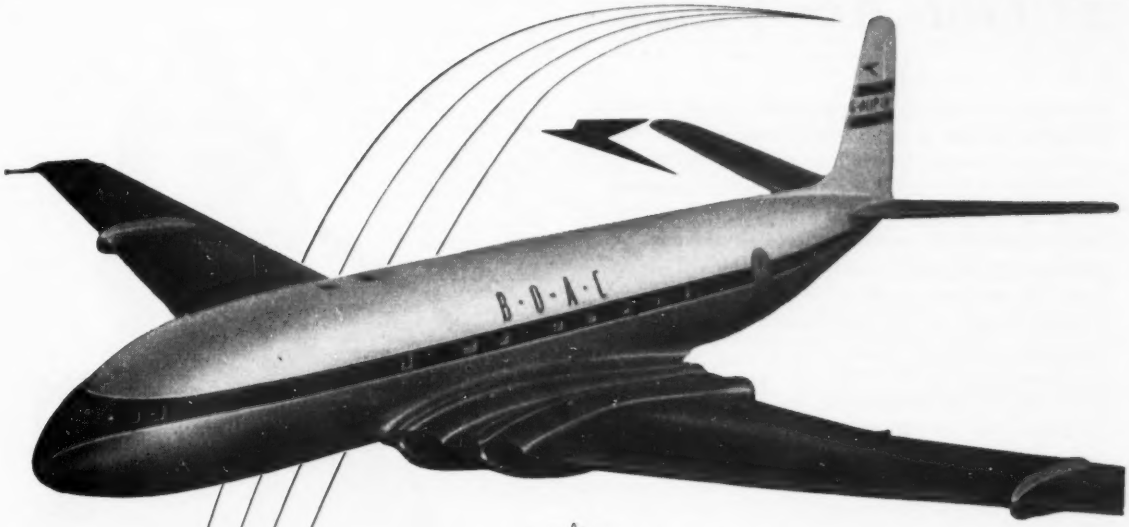
Fuel system.—As may be seen shaded in the illustration on page 551, all fuel is carried in the wing. It was not easy to find sufficient space in the Comet's thin wing for the required tankage. In the event, a bag tank has been placed in the centre-section under the cabin floor, while the major proportion of the capacity is contained by integral tanks formed by the outer wing structure. Total capacity is 5,976 gal (47,808 lb) of which all but 36 are usable.

Feed is by immersed booster-pumps, two in each tank, with suction feed available as an alternative. Particularly advantageous from the servicing aspect is the manner in which the booster-pumps can be removed through the wing under-surface without draining any fuel. The underside of the wing is liberally provided with tank inspection doors.

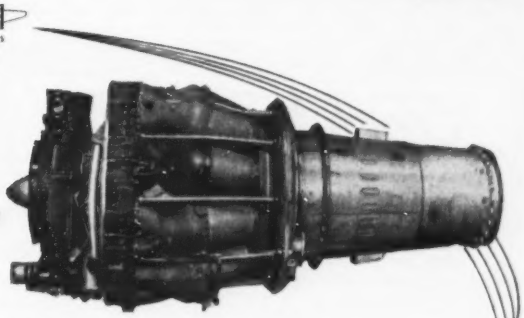
Refuelling, either by the underwing pressure method or by the more protracted over-wing process, has not proved difficult or delayed departures. The Flight Refuelling valves have worked admirably in controlling the torrent of kerosine during pressure-fuelling; the rate of flow is 200 gal/min from each socket. The fuel used has always been Shell A.T.F., a colourless kerosine of high purity.

B.O.A.C. are agreeably surprised at the behaviour of the integral

86/HT/4.



D.H ENGINES



One good trademark leads to another

Every British aircraft gas turbine has rotor blades made of one or other of the Nimonic Alloys. The use of a Nimonic Alloy is an assurance of reliability in any component that must resist stress at high temperatures.

HENRY WIGGIN

This is the Nimonic 90 blade that rotates in the Ghost engines that keep the Comets flying

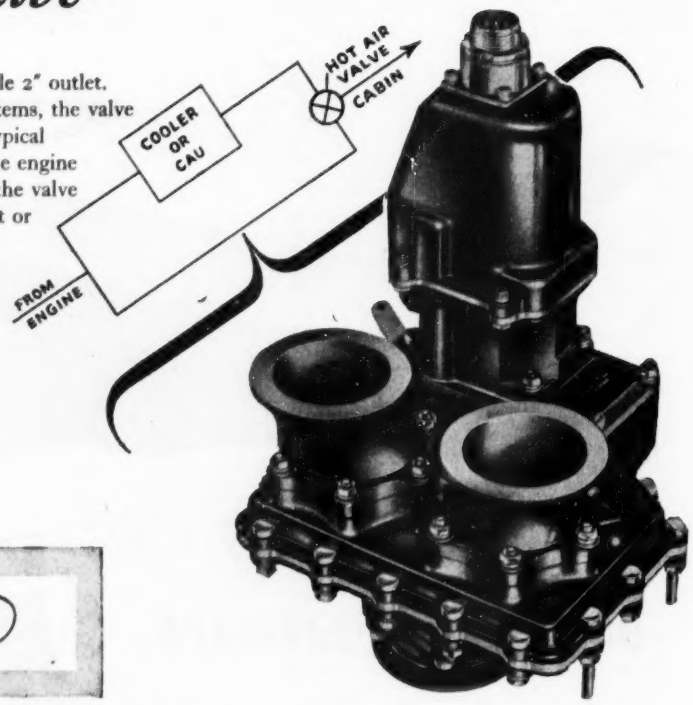
Nimonic is a Registered Trade Mark.

HENRY WIGGIN AND COMPANY LIMITED

WIGGIN STREET · BIRMINGHAM 16

2" Hot Air Valve

This valve has two 2" inlet ports and a single 2" outlet. Designed for use in cabin conditioning systems, the valve modulates between the two inlet ports. A typical application of the unit is a system where the engine compressor tapping is divided upstream of the valve to flow through the coolers and cold air unit or through their bypass. Downstream of the valve, the air flows direct to the cabin. The valve seals to 1 c.ft. per minute against a pressure of 75 p.s.i. at temperatures up to 350°C. The integral high temperature actuator is available in 3 or 15 seconds ratings and a follow-up lever is provided to give a feed-back to the control apparatus. The valve weighs 7 lb. 15 oz.



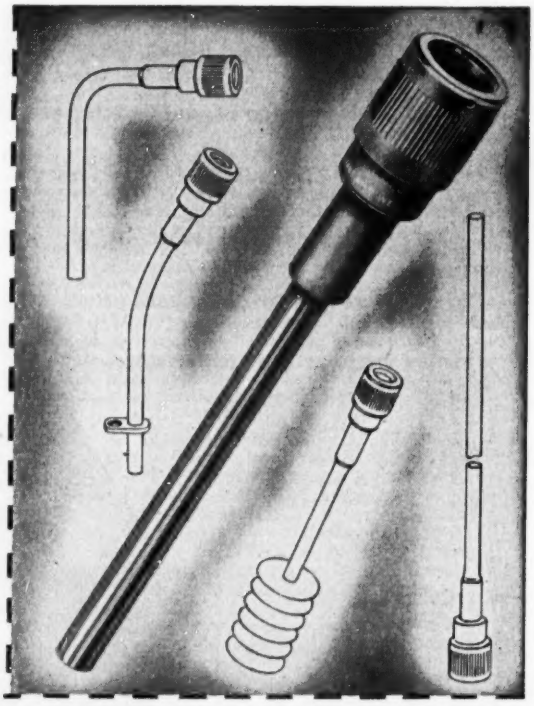
Teddington

Teddington CONTROLS

TEDDINGTON CONTROLS, LTD., CEFN COED, MERTHYR TYDFIL, SOUTH WALES. (Merthyr Tydfil 666)

Weston Resistance Bulbs

The Model S.110 Platinum Resistance Bulb, used in conjunction with a Weston circular scale indicator is greatly superior in every respect to other methods of temperature measurement. Its platinum element is the most stable, accurate and the smallest yet produced for practical applications. Due to the very small size of the resistance element, the response time is extremely rapid. Reliability and long life are ensured by the fact that the element is hermetically sealed into a ¼" o/dia. stainless steel sheath which is fitted with a watertight plug connection. The socket is moulded integrally with special cable which is supplied. The Model S.110 is suitable for temperatures between −200°C. and +500°C. Full details of Weston equipment for aircraft will gladly be supplied on request.



WESTON AIRCRAFT INSTRUMENTS

SANGAMO WESTON LIMITED
ENFIELD MIDDLESEX
Tel: Enfield 3434 (6 lines) 1242 (4 lines) Grams: Sanwest, Enfield
Scottish Factory: Port Glasgow, Renfrewshire
Branches. Glasgow, Manchester, Newcastle-on-Tyne, Leeds, Liverpool, Wolverhampton, Nottingham, Bristol, Southampton, Brighton

COMET ENGINEERING . . . .

tanks. Reduxing has greatly eased problems, but some leakage has been found around the various bolts fitted. It may be noted that the use of kerosine is of assistance in finding leaks, for it does not evaporate rapidly as would a more volatile petrol. Having removed the defective bolt, B.O.A.C. re-seal with a Dowty sealing bolt and a coat of a suitable Bostik compound. Inspection for any fuel leaks is simplicity itself. During such inspection, the engines are opened up to full thrust (maximum fuel pressure), with an engineer on the ground to examine the engine bays and tanks.

The venting of a high-capacity, thin-wing system might easily have given trouble, but the only fault—surprisingly enough—concerned the centre-section bag tank. The vents for this tank created a negative interior pressure sufficient to pull the tank off its mounting buttons and collapse the bag. A cuff over the vent, to apply ram pressure, cured the trouble. Apart from this, the Marston bags have served very well, although their rubber-laminated skin is no more than 0.020in thick.

Undoubtedly, the biggest fuel problem was the blocking of the filters by small ice crystals, in spite of the fact that ten water drains permit all free water to be withdrawn before the start of each flight. (It should be made clear that the kerosine itself did not freeze in any flight condition.) Since the only rapid cure was an increase in filter area, four additional units—actually big filters of the type used on the Venom fighter—were added in parallel. Icing may still occur but, on present schedules, cannot continue long enough to cause trouble.

It is unfortunate that no absolutely accurate fuel-contents gauge is at present available to meet the highly critical demands of turbojet flight-planning on long routes. This is no reflection on the Waymouth units fitted, which are considered the best available for the aircraft; but these gauges are of the condenser type and their capacitance varies to some extent with humidity. Certain items were originally prone to the ingress of condensed frost, accuracy thus being affected. It is believed that this trouble has been cured by sealing-off the external units and by applying special spacers and rubber-and-Bostik seals to the tank units. By so doing, the error, which at one time frequently reached 12 per cent, has been reduced to about 2½ per cent maximum.

Present fuel-contents procedure, therefore, is that a positive check is obtained before flight from each dripstick—a graduated tube which, manually pulled down through the wing undersurface, acts as a drain when the top is pulled under the surface of the fuel. Then, the precise initial fuel load being known, the Negretti and Zambra flowmeters are used as a basis for computing the amount burnt. It should be added that Waymouth are developing a very accurate gauge for the Comet Series 3.

Jettisoning is by no means a normal procedure, but it has been found quite efficient. The kerosine is blown out through the flaps under the pressure of ram air.

Electrics.—So extensive is the Comet electrical system that no more than a bare outline can be given here. B.T.H. is the company principally concerned, and they provide the large, 8.5 kVA, three-phase alternators, one of which is mounted on each engine. These are blast-cooled, but it has nevertheless been found necessary to shed load at high ambient temperatures during twin-engine taxying.

Their delivery, at 28 V, is rectified by selenium rectifiers, blast-cooled in their bay in the leading edge between the engines. From here the d.c. output is paralleled and the resulting amperage available can be anything up to 220 per set. Carbon-pile regulators keep the voltage between 27½ and 28¼. Lincoln or Murex trucks provide starting current; with the Ghosts running, the ground power limit per alternator is 150 amp.

Auxiliary power for numerous services is provided by inverter sets driven by d.c. motors. They provide supplies of single-phase current at 26 V, 400 c.p.s. and three-phase at 115 V, 400 c.p.s. Much of the related electrical equipment is Rotax. All the circuit-breakers and fuses are accessible in flight.

An early design-choice which is considered to have been amply justified was the siting of much electrical equipment in a pressurized equipment-bay under the floor of the forward fuselage. This has greatly reduced brush-wear of many components and also eases a number of temperature-variation problems. The bay, in which two or three persons can work at once, is accessible both from the ground and in flight. It also houses a great deal of the air-conditioning and hydraulic equipment, with beneficial effect on their functioning.

One early trouble with the electric system was a tendency for an abnormally heavy load to be passed to any alternator not working properly; lately, however, proper load-sharing has been achieved. A little difficulty was also experienced in reducing friction in the top alternator bearing; since each rotor runs at engine speed the heat generation could be considerable. The big roller bearing now fitted is satisfactory in this regard.

As regards brush-wear it may be recorded that this has only been discovered at 150-hr inspections, and has caused no in-flight power loss. Water sprays are not used.

Instruments.—Most important of the new instruments carried by the Comet is the Sperry Zero Reader. This equipment co-relates information from the C.L.2 gyro-compass, the sensitive altimeter, the artificial horizon and the cross-pointer I.L.S. indicator and presents the pilot with a unified picture enabling him to control the aircraft with ease during complex procedures. It has worked very well, in spite of the delicacy of much of the apparatus, and some re-calibration of the electronic computor unit is all that has been required.

The autopilot is the Smiths S.E.P.1 and it is spoken of very highly indeed. The Mk 2 version of this well-known installation, shortly to be introduced, differs in having a unified amplifier/junction box and in enclosing the gyro unit in a round case with Perspex top. The series 2 Comets will have the completely new S.E.P.2.

As mentioned by Capt. Majendie on page 559, a new pattern of Machmeter was introduced during the year. Two Machmeters were originally fitted, one having a blank dial and actuating a warning horn at $M = 0.76$. Later, this horn is to be energized by the visual instrument, the audible meter then being removed. It has been found that the Machmeters tended to under-read slightly, and that a more accurate determination could be obtained by computation from the other flight instruments.

Another modification was the adoption of the more-easily-read altimeter also referred to by Capt. Majendie, while an interesting superficial alteration was the substitution of the long Kelvin Hughes Mk 9 high-speed pitot head for the type formerly fitted. Other modifications mooted concern the Normalair pressure-controller; the electric actuators used therein—not made by Normalair—are to be replaced by clockwork motors. The controller itself may be reduced in size.

Altogether, the performance of Comet instruments has been quite definitely better than the usual level; in particular, unscheduled maintenance and the innumerable trivial faults caused by vibration have been gratifyingly rare.

Radio.—At present, the Comets in B.O.A.C. service carry a radio officer, in whose charge is the following equipment: Marconi A.D.F. Type AD.7092B is fitted in two independent installations. The H.F. communications transmitter is the AD.107, duplicated, and the H.F./M.F. receivers, twin AD.94. Standard Telephones V.H.F. is used, the set being the STR.12C, again duplicated (70 channels each set). Standard also supply the SR.14A/15A I.L.S. receiver and the intercom is by Ultra. Ex-R.A.F. Rebecca Mk 2 is carried, used in conjunction with M.C.A.-installed Type 953 ground responder beacons, while the unusual conditions in the Far East demand STR.9X and ex-U.S.A.F. Loran. The two latter sets are carried east of Calcutta only; the latter is a hyperbolic navigational aid and the former is necessary for communication around Japan, where military U.S.A.F. frequencies are specified.

It will be appreciated that this range of equipment virtually duplicates that carried by the Corporation's Argonauts and Hermes. As a result, it is all well proven and has given practically no trouble. In fact, during the whole of the Comet route-proving trials there was not one valve failure and the Comet radio failure-rate has remained at a remarkably low level. This is considered to be one of the benefits accruing from the smooth flight of the aircraft.

It is worth noting that all B.O.A.C. radio servicing is carried out at the Corporation's radio workshops near London Airport; a stock of spare sets is positioned at points on overseas routes and, when trouble is found, a new set is installed at once and the defective equipment sent to London. These spares are certificated before packing for shipment and, although nearly all is of a delicate miniaturized nature, the certification holds good until the set is unpacked. Incidentally, the location and history of every set in the Corporation is always known in London.

The performance of the Comet radio has been of a high order. At 40,000ft altitude the V.H.F. has been used over ranges of between 200 and 250 miles. Normal Loran ranges have been 750 miles by day and double this at night, while the Rebecca has been consistently used at distances above 150 miles.

With the A.D.F. it should be said that, with the ground non-directional beacon power laid down by I.C.A.O. convention for low-flying (20,000ft) aircraft, the Comet suffers from M.F. interference. For example, when approaching the "toe" of Italy the beacon at Idriss (Tripoli) gives trouble, while Luxor clashes with Heraklion. The A.D.7092 can go on to the Paris beacon direct from London, while the very powerful (10 kW) beacon at Manila is picked up immediately after take-off from Bangkok.

The ageing Rebecca is giving good service as the Comet's major static-free navigational aid. All the Rebecca installations provide the vital "distance to go" information needed for let-downs, while some of the B.O.A.C. Comet Fleet have nose-slot aerials giving an indication of left-right bearing. Using the rubber vizor, the Rebecca has proved easy to read even in bright, 40,000ft sunlight. The presentation is a Morse-coded cathode-ray trace.

But in spite of the good work done by the Rebecca sets there is a need for more modern equipment. Generally, British airborne radio is both lighter and more compact than any foreign equipment of the same performance. The Rebecca is an exception, and it is the only non-miniaturized set carried in the Comet. Modern developments along the line of interrogator/responder apparatus goes under the title of D.M.E. (distance-measuring equipment) and much work has gone into ensuring that suitable D.M.E. will shortly be available for the Comet.

It must be recorded that early work in the field was unsuccessful. Now, however, a different type of British D.M.E. is showing a good performance in trials and it is intended to adopt the set with pilot presentation. A later addition may be the installation of cloud/collision-warning equipment, as is fitted to the R.C.A.F. Comets.

The Comet radio installation is served entirely from suppressed aerials, the location of which is shown in the drawing on page 551. Although novel on a civil airliner, they have, on the whole, worked excellently. One fact, however, is perfectly clear: a fault in a suppressed aerial such as the Comet fin cannot be immediately rectified where doing so would involve modification to the aircraft structure. Tampering with suppressed aerials can, in fact, lead to all manner of airworthiness problems affecting the basic ability of the aircraft to fly.

Emergency equipment.—So far as fire prevention is concerned the Comet has had no trouble whatever—barring the ever-present inclination of flame-switches and detection devices to be over-sensitive.

The various extinguishing systems are shown in the sketches of the engine bay (page 552) and some equipment (page 551). The crew have full access to all freight and equipment bays in flight. Both Graviner and Pyrene are to be congratulated on the extremely light systems installed.

Escape hatches have given no trouble. Dinghies are not carried by B.O.A.C. Comets since, even around Okinawa, land is always within reach in emergency. It may also be noted that the flotation qualities of the Comet should exceed those of almost all other aircraft. In the case of a belly landing, wipe-off and inertia switches are arranged to switch-off fuel and electrics and actuate extinguishers and emergency lighting.

Furnishings.—The interior of the B.O.A.C. Comets has had an unusually hard first year of service, for load-factors have been consistently far above average. Nothing untoward has occurred, except for the interesting fact that the soundproofing material has shown a tendency to collect water. This characteristic, which is due to capillary action, has caused increases in empty weight of up to 100 lb., but is now cured.

W.T.G.

CIVIL JET OPERATIONS

B.O.A.C.'s Comet Experience - - - -

By CAPT. A. M. A. MAJENDIE, M.A., A.F.R.Ae.S.

A LECTURE of unusual interest, delivered on April 23rd by Captain A. M. A. Majendie, flight captain of B.O.A.C.'s Comet Fleet, before the Royal Aeronautical Society—a "main" lecture at the Glasgow branch—finds a particularly appropriate place in this issue of *Flight*. It is printed below—practically in full—with diagrams prepared from several of the illustrations.

The paper was confined strictly to the operational experience of B.O.A.C. gained in a year's operations with the de Havilland Comet 1 with four Ghost 50 turbojets. Symbols and abbreviations used were: V_{md}=minimum drag speed; W=weight; E.A.S.=equivalent air speed; T.A.S.=true air speed; 1 kg=2.205 lb. The lecturer dealt with his subject under separate headings.

CRUISING.—Characteristics of a turbojet aircraft are peculiar, and bear little resemblance from an operational point of view to those of piston-engined propeller aircraft. In particular, the dictates of efficiency allow very little basic freedom in the selection of cruising procedures, although a fair latitude exists in their detailed application. The need to fly high for long-range high-speed operation with a jet aircraft follows from the engine requirement of high r.p.m. in order to achieve a good specific consumption; the only method of equating thrust output against airframe drag for aerodynamic efficiency then being to use altitude in place of a throttle control. By this means it is possible to select the correct lift/drag ratio for optimum range at the same time as the best engine r.p.m. for specific consumption, equating thrust output with drag by flying at the correct altitude to achieve this for any given aircraft weight.

In practice, with a centrifugal compressor-type engine, best engine specific consumption (lb fuel/lb thrust) per hour is generally obtained at the maximum permitted r.p.m. consistent with a satisfactory overhaul life. For the purpose of a simple analysis the engine r.p.m. therefore can be assumed constant, variations of thrust output with altitude being dependent only on air density to a first order of accuracy. Because of the high fuel consumption of jet engines in comparison with piston ones, a relatively greater percentage of the aircraft all-up weight is burnt as fuel each hour of flight, and the total fuel load at take-off can approach 50 per cent of the total weight. It follows that there is a large progressive reduction of all-up weight throughout the flight, and that the thrust requirements demanded of the engine for a given lift/drag ratio decrease in the same proportion. To achieve this at constant r.p.m., height has to be increased progressively as weight diminishes, and this leads to the now well-known cruising-climb technique.

Under level flight conditions, if engine thrust can be varied without change of specific consumption, it can be shown that best range will be obtained by flying at the lift/drag ratio appropriate to a speed a little more than 30 per cent above that for minimum drag, as long as this speed is below the drag critical Mach number. In practice, for level operation at low altitude, considerable throttling is needed to achieve this speed. **As engine specific consumption worsens with reduction in r.p.m., it is advantageous on multi-engined aircraft to derive the greater part of the total required thrust from one or two engines operating near optimum r.p.m., and to idle or shut down the remaining engines.** The same argument holds good when holding at minimum consumption (*i.e.* maximum endurance conditions), which is achieved by flying as close to the speed for minimum drag as possible, consistent with altitude stability.

When engine r.p.m. is held constant at optimum engine conditions, any required lift/drag ratio can be selected by flying at the equivalent air speed appropriate to it for the aircraft weight at that time. It is convenient to relate this air speed to that for minimum drag, as by so doing it can be expressed independently of aircraft weight for a given lift/drag ratio or lift coefficient. Under these conditions of set engine r.p.m. and selected equivalent air speed at a given percentage above that for minimum drag, thrust required varies only with weight, and cruising height will settle down with the engine altitude-throttled to give the required figure, height increasing as fuel is consumed and weight diminishes. Operating in this way best range conditions are achieved at a rather slower air speed than for the level flight case already discussed, as true air speed does not fall as fast as equivalent air speed when the latter is reduced, owing to the increase in cruising height associated with such a reduction. Furthermore, below the tropopause, the temperature lapse rate gives an improvement in engine performance, over isothermal conditions, for a reduction of equivalent air speed, and consequent increase in cruising height, making an even slower operation desirable in this case.

[Four graphs were shown to illustrate these effects; two are reproduced here. The curves were for still air, the wind component being shown as a fraction of V_{md}. Based on this simple analysis, the effect of wind and temperature on range are shown in Figs. 1 and 2.]

It might be thought that a limitation on the selection of a cruising equivalent air speed would be imposed on grounds of stability, because of the need to preserve a suitable margin above V_{md}. It will be realized that this is not so since no attempt is being made to fly at a set altitude, and any temporary excess of drag over thrust will result in a descent to a level at which adequate engine output is again available. There is no theoretical or practical objection to a cruising-climb at, or near, V_{md} on this account, as long as other limitations do not intervene.

To carry out an actual operation successfully and efficiently, it is necessary to devise a practical cruise control procedure, so that the operation can be kept within practical limits of the optimum condition, without placing an undue burden upon the operating crew and within the limits of available instrumentation. The acceptable tolerances in this connection are much smaller for a jet than for a piston-engined aircraft, owing to the much greater weight of fuel burnt every hour expressed as a percentage of available payload capacity. As a result, relatively small increases in specific range (air miles/lb fuel) can improve considerably the payload capacity under limiting conditions.

Apart from being workable and efficient, the cruise control procedure adopted must enable a satisfactory presentation to be made of all those operational factors needed in the air and for flight planning. These include true air speed, time, distance, fuel, weight, height, endurance and so on, for an operation under given conditions. A vital factor in air safety is the presentation of this information to the operating crew in a simple and unambiguous manner, particularly for jet operations when time itself is at a premium.

[The lecturer, discussing measured performance, here referred to two charts of specific range against I.A.S. and T.A.S. respectively, drawn for temperature conditions of 15 deg assuming a continuous lapse rate and no tropopause. The second of these is illustrated, Fig. 3.]

For practical purposes it is convenient to suppress the tropopause and so to avoid discontinuities in presentation, particularly as most current operations are conducted in the troposphere. The variation of specific range with indicated air speed for a given weight is not as critical as might be expected theoretically; nevertheless, it is as well to stress again

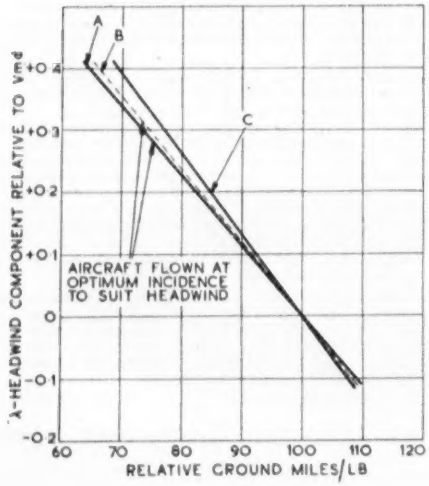
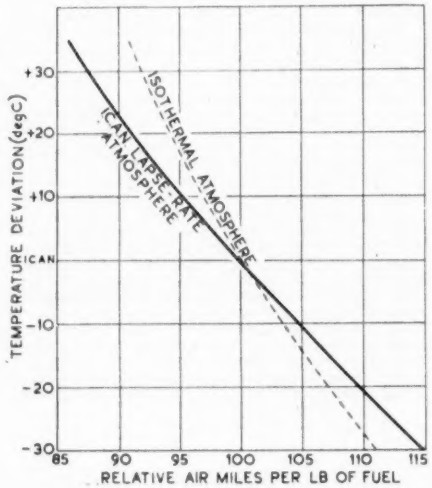


Fig. 1 (left) shows the effect of wind on range. A and B are "optimum-incidence" curves for I.C.A.N. and isothermal atmospheres, respectively. C is for a constant-incidence cruise such that $V_i/V_{md}=1.3$. V_i=E.A.S., V_{imd}=E.A.S. for minimum drag.

Fig. 2 (right) indicates the variation of range with air temperature. The curves are drawn for stabilized flight at a given weight and a fixed incidence.



TRAINING ECONOMIES

WITH Redifon
FLIGHT SIMULATORS

★ Specified by British Overseas Airways Corporation for Stratocruiser, Comet and Britannia crews, Redifon Flight Simulators will make a major contribution to safe training standards and bring about a complete change in the economics of aircrew training, at the same time ensuring the highest possible standard of efficiency under realistic conditions on the ground.

FLIGHT SIMULATOR DIVISION

REDIFON LIMITED, WEBBER STREET, LONDON, S.E.1

Service to Aviation

Most of the famous aircraft of the last thirty years, including the immortal Spitfires, Hurricanes and Wellingtons of the war period, used Airscrew propellers The Princess, Brabazon, Comet, Viking, Appollo, S55 and HP80 all use Airscrew fans. The designers of tomorrow's aircraft too, are aided by Airscrew mouldings, wind and smoke tunnels, fans and propellers.

THE AIRSCREW COMPANY & JICWOOD LTD

WEYBRIDGE · SURREY

Telephone: Weybridge 1600 · Telegrams: Airscrew, Weybridge

Makers of uniforms for Officers of the Royal Air Force

AUSTIN REED

of Regent Street

LONDON AND PRINCIPAL CITIES

755

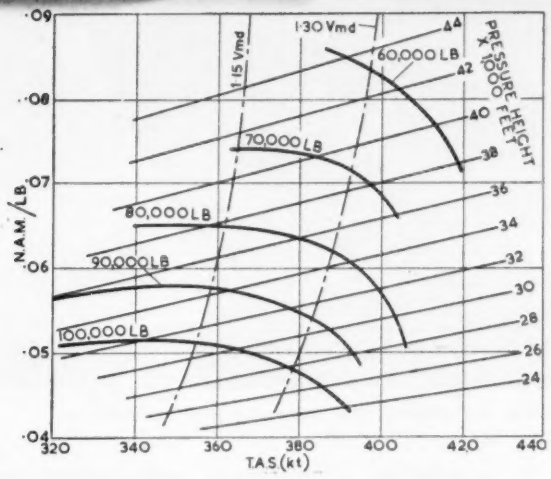


Fig. 3 (above) shows typical performance-curves based on T.A.S.

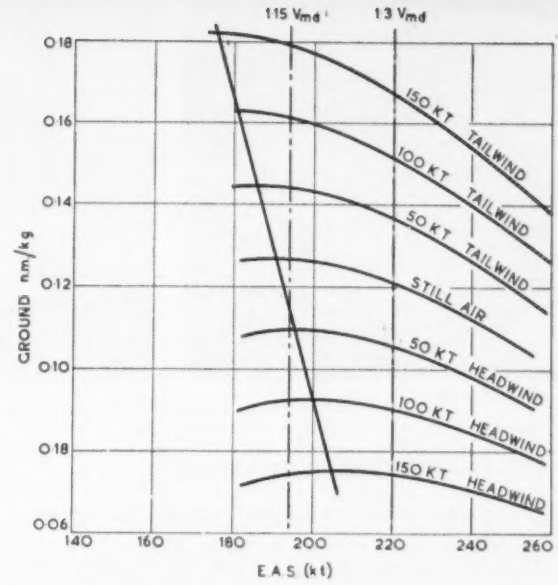


Fig. 4 (right) illustrates the variation of cruising performance with the wind component.

CIVIL JET OPERATIONS . . .

the importance of small changes in specific range when expressed in terms of payload. It will be appreciated, however, that quite a lot of flexibility exists in the choice of a satisfactory procedure.

It must also be remembered that the choice of a cruising procedure cannot be divorced from the climb fuel needed to reach its starting point. A small gain in specific range at altitude on a short sector can be completely discounted by the extra fuel needed to climb to a higher initial cruising level. To some extent the optimum procedure has consequently to be related to stage length.

Figure 3 shows specific range against true air speed for similar temperature conditions. It will be seen that there is a very heavy fuel penalty if an operation is attempted away from the best range conditions, to gain a worthwhile increase in speed.

On current operations with the Comet 1, B.O.A.C. is using a constant incidence cruise procedure, achieved by flying set values of indicated air speed against aircraft weight, an adjustment being made every half hour. For a given incidence and set engine r.p.m. it is possible to consolidate all the cruising information on to a single graph. From this it can be seen that variations in temperature have surprisingly little effect upon cruising endurance; they do, however, have a considerable effect upon cruising height. It might be supposed from this that flight under conditions of pronounced horizontal temperature gradient, causing rapid changes in cruising level, would show marked deviations in performance from normal conditions. So far it has not been possible to detect any such effect.

Under constant incidence cruise conditions at set engine r.p.m. it can be shown quite simply that both true air speed and Mach number are uniquely related to ambient temperature only, irrespective of aircraft weight or cruising height, provided that the flight is under stabilized conditions. These relationships enable useful simplifications to be made in the tabulation of cruise control data. It should be noted that Mach number increases as ambient temperature falls, and that operation below a given temperature may lead either to an excessive drag rise, or to control difficulties. Such a condition is not encountered on the Comet 1, but if it were it would then probably be best to abandon the constant incidence technique upon reaching a suitable Mach number, thereafter operating at this constant Mach number.

CRUISE CONTROL IN PRACTICE.—Although operations can be conducted from a suitable set of performance graphs, similar to the figures already shown, this does not provide a very good method of presentation for practical use. Experience has shown that tabular information is less likely to be misinterpreted, and is generally easier to use.

The effect of a wind component upon the cruising procedure is shown in Fig. 4. Even a headwind component of the order of 100 knots makes very little difference to the optimum cruising conditions and, as far as Comet I operations are concerned, it is current practice not to alter the standard procedure even when extreme conditions are encountered. It might be expected that there would be a potential gain in cruising at a different level under strong wind conditions, particularly if the wind were rather localized, as in a jet stream. This is not so as this type of aircraft is particularly inflexible as far as altitude is concerned. The normal cruising level is very close to the absolute ceiling, precluding any attempt to climb out of strong wind conditions, and the range penalty for descending is so heavy that the headwind component would have to fall off by considerably more than 10 knots per 1,000ft loss of height to justify descending. **The only correct technique to avoid jet stream winds is by flying out of their effect horizontally.**

Before leaving the subject of cruising some reference must be made to the subject of engine failure. If an engine fails at cruising height the aircraft will then be above both its three-engined ceiling and the optimum level for a three-engined cruise, which for the Comet is about 10,000ft lower, for a given weight. Although specific range under stabilized three-engined cruise conditions is seriously below that for a normal operation, being about 20 per cent less, the benefit of the excess height at engine failure considerably reduces the penalty. In order to obtain the maximum benefit from the extra height, a carefully controlled descent to the three-engined cruise level is made, taking about an hour; for ease of reference this controlled descent is now known as a "drift-down."

CLIMB AND DESCENT.—A much larger proportion of a normal flight is devoted to climbing to cruising level and descending from it than is normally the case with a piston-engined propeller aircraft. **The operation of a jet aircraft bears a much closer resemblance to the flight of a projectile than does that of traditional types.** For this reason the overall efficiency can be considerably affected by using different techniques for climb or descent. As specific range is extremely poor at low altitudes, there is an obvious requirement to climb as fast as possible directly after take-off, and maximum permissible engine r.p.m. is used for this purpose. Considerable latitude exists in the choice of climbing speed as far as performance is concerned; a fast air speed on the climb being theoretically better than a slow one at any given point for specific range at a reasonable rate of climb, but demanding a prolonged period of flattened climb at low level, and excessive engine consumption, in order to gain the initial speed. Such a climb also suffers from the disadvantage of possibly providing an operation at speeds well above those recommended for use under turbulent conditions, which are not infrequently encountered in the earlier stages of climb after take-off.

As far as descent is concerned, the most efficient method is a long shallow operation, which, on range alone, provides a gain of about 20 per cent over normal cruising for an equivalent distance. However, if height is held until nearly overhead destination, and a rapid descent is then made, there is a penalty in view of the fuel burnt during this rapid descent, it being impracticable to shut down the engines owing to the requirements of pressurisation and other ancillary power demands. This further penalty lifts the total fuel requirement for a delayed descent to a figure about 40 per cent above that needed in the optimum case, not taking into account the maximum descent rate which can be tolerated in the passenger cabin of a public transport aircraft, which would still further increase the penalty. The importance of this limitation will be understood from the example of the Comet 1, which is pressurised to a maximum working differential of 8¼ lb/in², providing a cabin altitude of 8,000ft at a cruising level of 40,000ft. It follows that the time taken to descend from 40,000ft must not be less than that needed to bring the cabin from 8,000ft to surface pressure. A seriously delayed descent, making allowance for this requirement, can impose an even greater penalty than the examples already given. Nevertheless, such a delayed descent has the operational advantage of preserving altitude, and therefore diversion range, to a much later stage in a given operation should weather conditions for landing be doubtful at destination. As in the case of the climb, speed on the descent is not very critical, and a fair latitude exists in making a suitable choice of procedure.

TAKE-OFF.—Take-off technique on a civil airliner is, to a large extent, governed by mandatory performance requirements laid down in

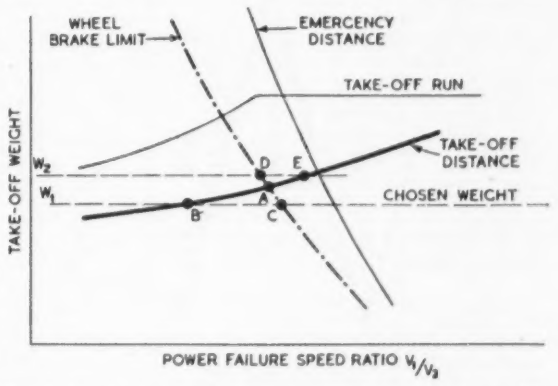
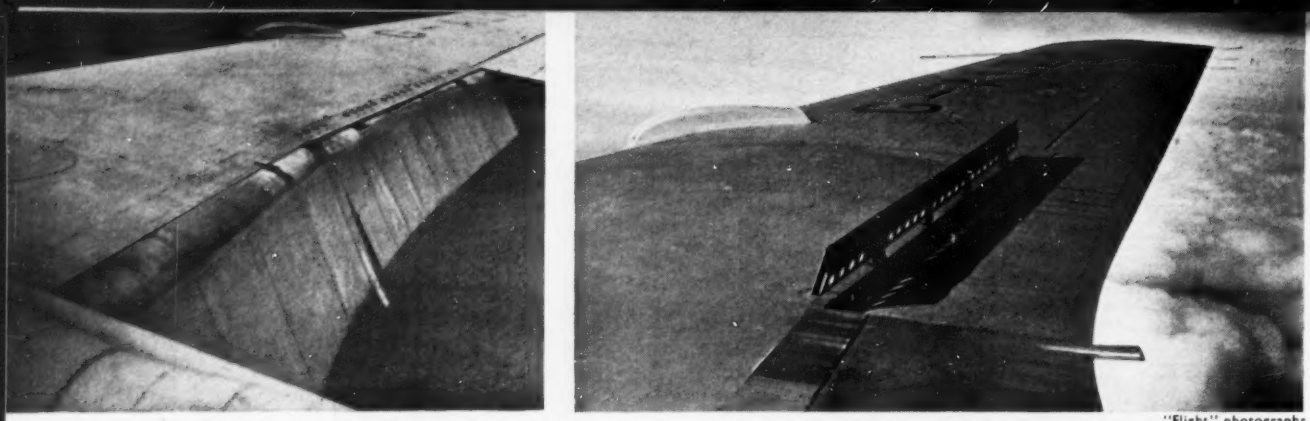


Fig. 5 shows the curves from the Comet flight manual—in simplified form—upon which are based take-off calculations.



"Flight" photographs

The Comet's large flaps and air-brakes, both of which, as explained by Capt. Majendie, play an important part in its operations.

CIVIL JET OPERATIONS . . .

the current Air Navigation Regulations and British Civil Airworthiness Requirements.

For a given take-off on a particular runway under known conditions of wind and temperature and so on, it is possible to construct a graph, similar to that shown in Fig. 5, from the scheduled performance data in the Flight Manual. Such a graph is essentially a plot of weight against speed, although it is convenient to plot speed as the fraction of the take-off safety speed at which engine failure is assumed to occur. **Take-off safety speed is the minimum safe speed at which the aircraft should be climbed away from the ground, currently set at 15 per cent above the stall. It has been suggested that this is not an adequate margin for a jet aircraft, because of the absence of slipstream over the wings and so on; experience on the Comet so far does not, however, indicate any need to increase this figure, particularly in view of the excellent asymmetric handling qualities of the aircraft, due to the close spacing of the engines from the fuselage centre line and the absence of airscrew drag from a failed engine.**

Fig. 5 shows that as the speed at which engine failure occurs is increased so the requirements of take-off distance and take-off run can be met at increasing weight, while that for emergency distance can only be met by decreasing it. The kink in the line for take-off run indicates the power failure speed ratio above which the all-engines-operating requirement becomes more severe than the engine failure case. It will also be noticed that there may be a kinetic energy limit on the speed at which an emergency stop can be attempted, if there is a practical limit upon the thermal capacity of the wheel brakes.

It will be seen that the lowest point of intersection between the two sets of conflicting requirements provides the maximum weight at which all can be met in full throughout the take-off. This point, *A* in Fig. 5, also indicates the critical speed below which, if an engine should fail, an emergency stop should be made, and above which the take-off should be continued on three engines. At any lighter weight, W_1 for example, there will be a range of speeds, between *B* and *C*, throughout which either decision can be safely made; at a heavier weight, W_2 for example, there will be a range of speeds, between *D* and *E*, between which a safe operation is not possible in the event of engine failure.

From graphs such as Fig. 5 it is possible to construct consolidated and simplified charts for use on any given runway.

LANDING.—Comet experience has shown that the certification performance requirements for landing are much less severe operationally than are those for take-off. That this is so is a measure of the success achieved by the designers of the Comet in keeping wing loadings and stalling speeds down, and in providing sufficient aerodynamic drag to compensate in large measure for the absence of propeller windmilling drag, or reverse thrust. However, because of the slow throttle-response characteristics of turbine engines, and the relative aerodynamic cleanliness of any jet aircraft, rather more accurate control of both speed and height is demanded from the pilot than is generally needed on conventional types of civil aircraft. **Automatic speed control on the approach would seem to be a most important field of study for future development.**

Jet transport aircraft are entirely dependent on wheel brakes and nose-wheel steering for final control on the landing run: asymmetric engine power for directional control, and aerodynamic reverse thrust both being noticeably absent. Although operational experience is still lacking in this matter, it would seem that there may be a major control problem when landing upon icy or slippery runways. This problem will be much accentuated in the future if wing loadings, stalling and approach speeds, and landing weight, are all allowed to increase in new types, without any offsetting improvements in methods of control on the ground. **Future trends in air safety will depend in very large measure upon the extent to which it will be possible to resist the tendency to sacrifice good approach and landing qualities for high performance: there should be no place in civil aviation for "hot" aircraft.**

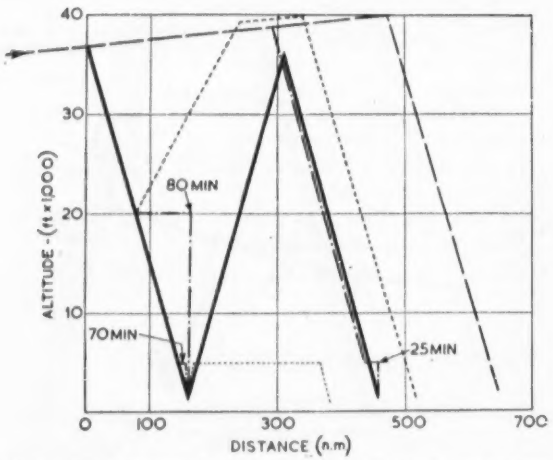


Fig. 6. Some of the ways in which a fixed quantity of fuel may be burnt, starting from the point in the upper left corner.

TRAFFIC CONTROL.—The economic penalty in delaying approach and landing of a jet aircraft on arrival at its destination is extremely heavy, and potential diversion range is seriously reduced as altitude is lost. The general order of these effects is shown in Fig. 6, which shows a number of ways in which a given quantity of fuel can be used from a common starting point at the top of a normal descent to destination. In this connection, it should be noted that the main penalty in low altitude holding of a multi-engined jet aircraft is the reduction in available diversion range, should this be needed, and not the relatively much smaller increase in holding consumption. Similarly there is a serious range penalty if restrictive low altitude limits have to be imposed for traffic reasons upon the initial climb after take-off.

Under ideal conditions the Air Traffic Control requirements for the efficient handling of jet aircraft are, briefly, as follows. Clearance to start engines before take-off should only be given when it is possible for the aircraft to start up, taxi out, and take-off, without delay, and then to climb without restriction along some suitable routeing to its cruising altitude. At altitude, under cruising conditions, it must be cleared to follow a route which provides lateral separation from other aircraft, so that altitude restrictions are not placed upon the cruising procedure adopted. Descent clearance should not be given into a controlled air space until the aircraft can be given an uninterrupted descent path to its final approach to land. If a subsequent diversion becomes necessary, an immediate clearance to climb out along a suitable route must be given, as a low altitude clearance will penalise the operation seriously.

These requirements are Utopian in practice. The worst deficiencies are found at present for the arrival, rather than for the departure case, and the problems of *en route* separation have not yet been tackled seriously at all.

Given good air brakes, such as are fitted to the Comet, descent rates of up to 4,000ft/min can easily be employed in instrument procedures. This ability to lose height quickly provides a very real measure of flexibility for inbound clearances, and approach procedures. This flexibility is now beginning to be exploited, and the day can be foreseen when the aircraft unable to descend steeply will be at a very serious loss in complying with Air Traffic Control requirements: powerful and effective air brakes are now becoming an essential requirement, and must be fully effective within the turbulence speed range of the aircraft and be provided with satisfactory protection under icing conditions.

The very much higher speeds now being used in air transport, and the increasingly critical operational requirements, have placed new and stringent demands upon the aeronautical communication networks. The introduction of jet aircraft upon some of the world's trunk air routes has underlined glaring deficiencies in the existing arrangements. **Flight safety and operational efficiency can only be built around a fast, efficient, and utterly reliable communications network.**

METEOROLOGY.—When the early development route flying was started with the Comet, there was surprisingly little operational knowledge available for flight above about 20,000ft, despite the fact that fighter aircraft had been making ascents to 40,000ft, and above, for some years. Such ascents were strictly localized, however, and route knowledge was conspicuous by its absence.

The most important single requirement for successful jet operations is not associated with upper cruising levels: it is the provision of really reliable forecasting of terminal and alternate weather conditions. The heavy-fuel penalty of a wave-off diversion has already been stressed, and the only method of avoiding it is a really sound forecast office. At the present time it would seem to be a better investment to spend money on developing improved terminal forecasting facilities, rather than on trying to build an adequate network of upper

air meteorological reporting stations. For jet operations, the aim must be to provide a service of such a standard that descent is never started towards an aerodrome, the conditions at which subsequently deteriorate to such an extent as to preclude a landing.

Despite its cruising altitude, the Comet is not yet by any means over the weather at all times. Whole stages are sometimes flown in cloud in the tropics, and severe turbulence can occasionally be encountered up to, and above, 40,000ft. Genuine over-the-weather operation will only become possible when the cruising level is at all times in the stratosphere.

There is still a great deal to be learnt about the wind velocities aloft at the new cruising levels. Narrow belts of strong wind (rather unfortunately named "jet streams") present new problems both to the forecaster and to the pilot.

Despite what has been said about the practical difficulty of extending adequate upper air coverage on a worldwide basis, there are undoubtedly special areas where an increase in the upper air reporting network would pay big dividends. An increase in the radio navigational cover in such areas can also play a very big part in increasing the accuracy and amount of in-flight data collected. It seems, from experience gained on the Comet up to the present, that the broad picture of the upper air, already constructed on theoretical grounds, is mainly correct and that it only remains to fill in the details as operational knowledge builds up.

Before leaving this subject, the importance of the collection of meteorological statistics for planning purposes must be emphasized. This is particularly so in relation to take-off conditions from critical aerodromes, for which it is necessary to have data covering not only runway wind components and surface temperature, but also the correlation between the two. This need to relate different meteorological factors on a statistical basis is a relatively new concept, and much work of this nature will have to be done in the future.

NAVIGATION.—Principles of navigation of a jet aircraft are not fundamentally unlike those for any other type, but the tempo has increased considerably. Speed of working is relatively of much greater importance than absolute accuracy, and this is leading to the development of new techniques. A typical example is provided by the problem of determining true air speed. Conventionally this would be accomplished by applying to the air speed indicator reading a series of correcting factors, one of these being ambient temperature, which can itself only be determined after applying a factor dependent on true air speed to the indicated temperature. However, by combining Machmeter reading with indicated (or "gauge") temperature, it is possible to derive both true air speed and ambient temperature directly, to a reduced but acceptable order of accuracy.

By methods such as these, great simplifications have been introduced into the routine work of navigation. But the performance characteristics of the jet have also led to some more fundamental changes in the navigational approach. The dependence of range and speed upon altitude now makes it impossible to present adequately the navigational situation upon a two-dimensional plotting chart: the operation has become essentially three-dimensional.

In order to achieve a satisfactory operation, it has been found necessary to establish a very close inter-relationship between the cruise control and the navigation, and this has led to a need for very good teamwork between the members of the aircraft's crew.

An essential requirement in the safe operation of a jet transport aircraft is a regular check upon flight progress in relation to remaining fuel. For this purpose a graph of distance to go plotted against remaining fuel is constructed as a standard part of the flight plan. Actual flight progress is then plotted on this graph, generally known as the "howgozit," as the flight proceeds, and unexpected trends become obvious very quickly. Lines showing performance in the event of engine failure are also included on the "howgozit," and this enables a safe decision to be made without delay in an emergency.

Astronomical navigation is only used to a rather limited extent. Surface map reading is equally doubtful and, even in good conditions, the accurate establishment of position by this means is very difficult at height. The navigation of fast, high-flying, aircraft is now essentially dependent upon radio aids. Upon the Commonwealth routes operated by B.O.A.C. these are almost exclusively confined to the medium frequency band, with all its known shortcomings. With the advent of high-speed jet operations, adequate long-range track guide and distance-to-go information is becoming urgently needed.

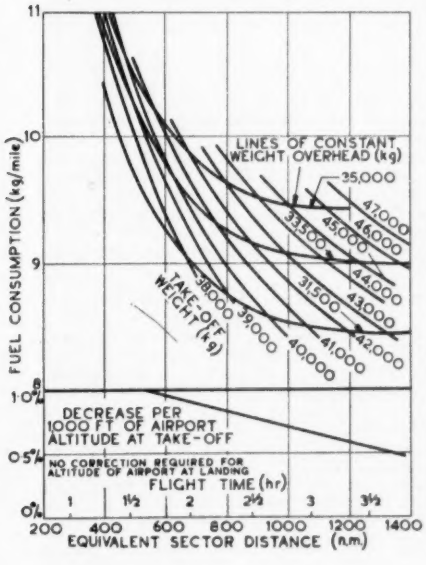


Fig. 7. A family of optimum-range curves expressed in weight of fuel burnt per mile. The correction for temperature can be taken as — 1 per cent for each 5 deg C below the +15 deg C standard.

ROUTE APPLICATION.—The jet airliner can only justify itself on long distance trunk route operations: it is essentially a high-speed, high-altitude, vehicle. The quantity of fuel needed to lift it to its normal economic cruising level is such that short-range operation cannot possibly be achieved at a reasonable mean figure for specific range. Furthermore, any increase in operating weight (e.g. extra fuel reserves) increases the overall consumption to a much greater extent than it does on traditional types of transport aircraft: the extra fuel burnt on an average stage being of the order of 25 per cent of the corresponding increase in operating weight.

It follows that fuel consumed per ton-mile tends to decrease as stage length, and the proportion of time at cruising altitude, both go up. Increase of stage length, however, also tends to increase the mean operating weight; and the average consumption per aircraft hour, at a given payload capacity, reaches its minimum value for a stage length well below that for best consumption per ton-mile of payload carried. This effect is dependent on the fact that the most productive part of the operation is the cruise at altitude, and that short sectors, much of which is spent in climb and descent, can only be operated at a relatively low mean speed, which more than offsets any apparent benefit in reduced average hourly consumption. These general effects are shown for the Comet I in Fig 7, which gives the average consumption in kilograms per mile against stage length. Any failure to appreciate clearly the difference between these two quantities in assessing the potential route application of a jet transport can lead to serious errors.

SPECIAL FEATURES.—At this point Captain Majendie referred to fundamental new features accompanying the advent of jet airliners. Of power-operated flying controls he said: "Aircraft response must be related to control operation in the best possible manner. This opens a whole new field of research which we cannot afford to neglect."

Of air brakes, to which he had already referred, he said: "They add a flexibility to the control of both height and speed which enables the pilot to achieve a precise operation otherwise denied him." Their omission from any future design would constitute a grave deficiency.

Regarding high Mach numbers, he stated: "The margin between the highest desirable cruising Mach number and that for aerodynamic instability or serious trim change may not appear very much in the eyes of those accustomed to current airworthiness performance margins. Inadvertent operation to an unduly high Mach number is not likely to occur very often on civil jet aircraft owing to the precise control of the operation called for from the pilot.

"The consequences of pressurization failure at the new high operating levels are so serious," said the lecturer, "that the design of the pressure hull and the associated method of supply and control of pressurized air must be beyond reasonable risk of failure. The only reasonable criticism that can be made operationally is the limitation in having to restrict the actual descent rate of the aircraft because of the need to keep it in step with the cabin altitude." He added: "There may be too serious a structural weight penalty to allow full sea-level pressure to be achieved in the cabin, but a compromise solution with a cabin at a lower height than is current practice would go a long way towards meeting the requirement." The lecturer then continued:—

SPECIAL INSTRUMENTATION.—New types of operation inevitably raise new requirements in instrumentation, to which some reference will now be made. It is logical to start with the Machmeter, the most important of the new instruments. In early Comet operations a standard service instrument was used. This was adequate as a safety indicator, but provided neither the accuracy nor the scale range needed for use as a quantitative indicator in its own right. Accordingly a modified type was introduced and a calibration accuracy of ± 0.005 Mach was achieved over the cruising range on the scale, enabling the instrument to be used for the purposes already described, thereby vastly increasing its value to the operation.

Probably the altimeter is the next most important instrument in terms of air safety. As with the Machmeter, a standard service instrument was used in the early Comet operations. It was soon found that serious mistakes in interpretation could occur when the instrument had to be read under stress, mistakes of 10,000ft not being unusual. In consultation with the instrument manufacturers, B.O.A.C. then sponsored a revised presentation on which the pointer indicating tens of thousands of feet has been brought outside the other ones. Reference to it alone is sufficient for an approximate estimate of height, e.g., during rapid descent.

Perhaps the next most important instruments are those concerned with fuel measurement, namely tank contents gauges and flowmeters. No really satisfactory method of indicating fuel contents has yet been evolved to the necessary order of accuracy, and this constitutes an urgent operational requirement. As flowmeter accuracy has been found in the light of practical experience to exceed by far that of the available contents gauges, it has become current B.O.A.C. practice to integrate the fuel flows, and to keep a continuing check between remaining fuel, and recorded flows, by this means. Great simplification will be possible in the operating drills, given adequate instrumentation, and this must also improve flight safety.

Finally, the importance of three standard instruments to the new operation must be stressed. These are the engine tachometers, the outside air temperature gauge, and the clocks. All have been important instruments in the past, but have now sprung into new prominence to meet the changed requirements of jet aircraft. Engine performance has become sensitive to r.p.m. to an extent previously unknown, and ambient temperature is now an important performance parameter. But time itself is the final yardstick in flight, the secret both of success and safety, and ultimately the most precious commodity in civil jet operations.

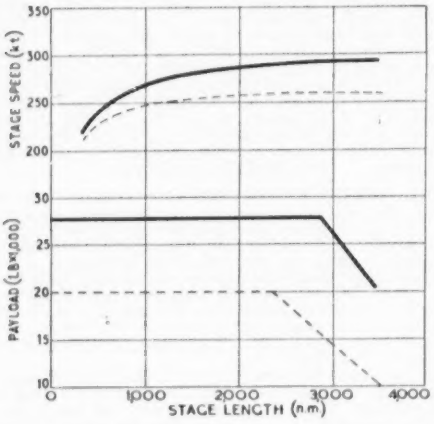
ASSESSMENT of OPERATING COSTS

Extension of Standard S.B.A.C. Method to Meet Modern Conditions

EXTRAVAGANT and conflicting claims by aircraft manufacturers for the qualities of their products have, in the past, added much uncertainty and difficulty to the task of impartially comparing different types. The Society of British Aircraft Constructors took a useful step, therefore, in producing—some three years ago—their standard method for estimating the direct operating costs of aircraft. Although not the only available method, it was at that time one of the most realistic and up to date, and did enable objective assessment of different aircraft types to be made. Being based on practical operating experience, its calculations were, of course, confined to piston-engined aircraft.

Now published is an amended version* of this method, which includes revised and additional information resulting from more recent operating experience. In particular—and here lies the main importance of the new version—it makes possible the calculation of performance and costs of turbojet and turboprop aircraft, which in turn now enables legitimate comparisons between turbine-powered and piston-engined machines to be made.

As before, the objects of the method are stated to be "to aid a potential operator to assess the economic suitability of an aeroplane for his operations, and to provide a ready means for comparing the operating economics of competitive aircraft in a standard set of conditions." There is no doubt that, for comparative purposes especially, the method is of undoubted value to both operators and manufacturers. Mr. R. V. Perfect, chairman of the technical panel responsible for the revised method, has stated that the new turbine figures are in fact conservative; the panel's calculations have erred on this side in order that the method should not fall into disrepute through an over-optimistic assessment of the jet's



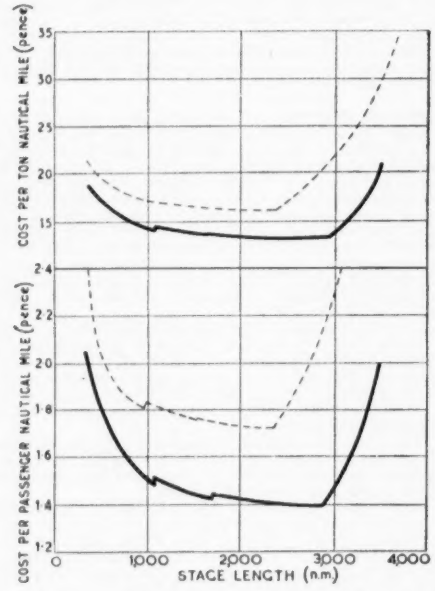
Curves showing speed and pay-load comparisons between the Britannia 300 (solid line) and an American aircraft—probably the DC-7 (dotted line). Using maximum-range technique, the mean cruising speeds are about 304 kt and 267 kt respectively.

economy. With further operating experience, the figures are likely to be revised—in particular, turbine overhaul costs should decrease markedly in the future.

The new version of the method retains the original main subdivisions of costs, and the alterations and additions to specific items are as follows:—

For turbine engines the spares holding (used in calculating the power-plant obsolescence costs) is to be taken as 75 per cent of the total power-plant cost, compared with 50 per cent for piston engines, due to the closer resemblance of turbine power-plants to the bare engine. Maintenance and overhaul costs for turbine engines are grouped together at 25 per cent of the engine first cost: for piston engines there remain separate calculations for these two factors.

Ground fuel consumption assessments for turbine aircraft are more favourable than those for piston-engined aircraft for starting and final checks, but more severe for taxying. The starting allowance is for five minutes at ground idling r.p.m. (compared with 8.5 minutes for piston-engined aircraft), while the taxying allowance is 2 lb (turboprop) or 4 lb (turbojet) per 1,000 lb of relevant aircraft weight (compared with 1.7 lb per 1,000 lb for piston-engined types). Oil consumption for turbine engines is negligible,



A comparison of costs per ton-mile (top) and per passenger-mile (bottom) for the two aircraft. The economy of the turboprop engines, especially between stage lengths of 1,000 and 3,000 miles, is evident. The S.B.A.C. method, for the first time, enables such comparisons to be made.

while the assumed cost of oil for piston-engined aircraft is 4 per cent of the fuel cost.

These factors, together with basic aircraft and engine data, are fed into the standard equations and the unit direct costs obtained.

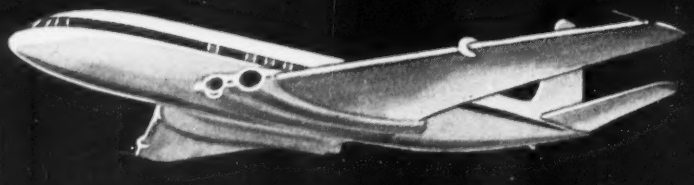
An interesting change from the earlier calculations is that the assumed aircraft insurance rate (for both piston-engined and turbine-powered types) has come down from 6 to 5 per cent, following a similar change in actual premiums charged due to an improvement in the record of aircraft accidents. In addition, figures for freight insurance premiums have now been incorporated. Increases in fuel, oil and landing costs have been reflected in the S.B.A.C. figures, and have resulted in generally higher flying costs. There have been similar increases in the maintenance and overhaul charges.

The Method Applied.—Shown in the graphs on this page are illustrative examples of the performance of two projected airlines, calculated on the basis of the revised S.B.A.C. method. The two aircraft are the Bristol Britannia Mk 300 (assumed to carry 104 seats), and an American aircraft which, from an analysis of the performance, appears almost certainly to be the 76-seat Douglas DC-7.

In terms of speed, payload and specific cost, the turboprop machine is seen to be the more efficient. The assumptions are for the maximum-range cruise procedure; calculations based on the maximum cruising-speed procedure show almost identically shaped curves, the main differences being the reduced range, and the obviously increased speed, which have comparable effects on both aircraft.

* *Standard Method for the Estimation of Direct Operating Costs of Aircraft.* Issue No. 2. Available from the Technical Section of the Society of British Aircraft Constructors, Summit House, Langham Place, London, W.1. Price 5s.

VICKERS VISCOUNT
Trans-Canada Air Lines are to introduce the Viscount on their inter-city services towards the end of 1954. It will then become the first turbine-engined airliner to operate in North America.
FOUR ROLLS-ROYCE DART PROPELLER-TURBINE ENGINES
Vickers-Armstrongs Ltd., Aircraft Division, Weybridge, Surrey



The De Havilland Comet

London – Tokio and back

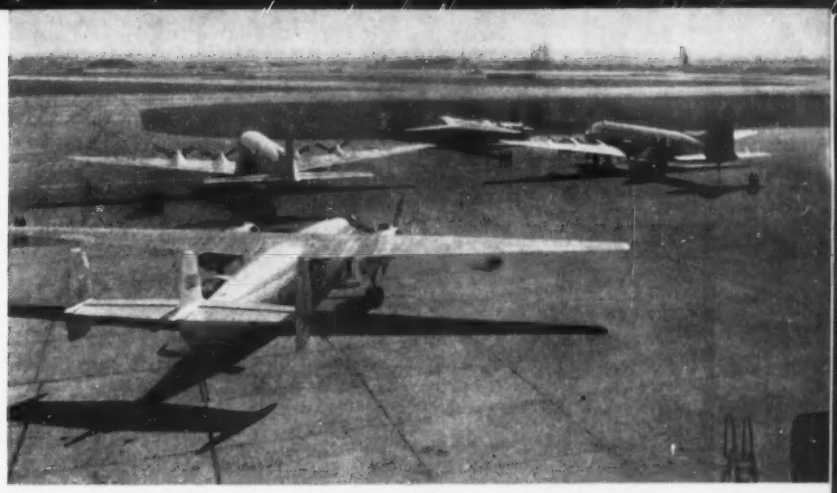
in less than four days

Travel and arrive fresh

"NORMALAIRED"

NORMALAIR LTD. MANUFACTURERS OF CABIN ATMOSPHERE CONTROL HIGH ALTITUDE BREATHING EQUIPMENT YEOVIL ENGLAND

CIVIL AVIATION



"Flight" photograph
AFTERNOON SCENE on the apron at London Airport, featuring two B.E.A. Elizabethans, a U.S.A.F. Skymaster (right) and a DC-6B of S.A.S. Details of new Elizabethan services are given at the foot of this page.

THE COMET AND THE C.A.A.

DESPITE some rather gloomy comments published recently on the subject of negotiations involving the certification of Comets in America, the prospect may be brighter than is at present generally supposed. It will be remembered that a clause in the Pan American World Airways contract for Comet 3s stipulated that unless the Civil Aeronautics Administration signified its willingness to certificate the type, or to accept the British certificate of airworthiness, the contract would become void. In inserting this clause, PanAm were obviously concerned with the spirit rather than the actions of the C.A.A., since it was obviously impossible for the Comet 3 to be certificated by March 31st, the date stipulated. The prototype Comet 3 will not fly until 1956, and neither the A.R.B. nor the C.A.A. can issue a certificate of airworthiness until several hours of test-flying have satisfactorily been completed. To date, negotiations with the C.A.A. have not produced the required assurance that, so long as the aircraft proves acceptable to our A.R.B., the American authority will almost automatically licence it for operation in America.

Nevertheless, it is significant that P.A.W.A. have extended the date in the "time-clause." This action confirms the belief that the American airline's declared intention to operate Comets is completely genuine. Details of the P.A.W.A.-de Havilland contract have not been published but it is believed that the former company would forfeit a considerable dollar deposit—already placed with the manufacturer—by cancelling the contract. The question of certification is essentially one for negotiation between government departments, and the two companies commercially concerned have not issued any official comment.

The A.R.B.'s recent mission to Washington, made for the express purpose of discussing Comet 3 certification, evoked polite but somewhat evasive reactions from the C.A.A. The American attitude was that until the C.A.A. had formulated its jet-transport requirements it could not decide whether or not the Comet complied with them. This answer implied a refusal to accept the standards evolved by the A.R.B. in studying the Comet and finding it airworthy; it also ignored the fact that B.O.A.C. had been using the aircraft on scheduled services for the best part of a year.

While sympathizing with the C.A.A.'s unwillingness to commit itself too deeply on a subject of which it has very little first-hand knowledge, we feel that its present attitude is both insular and over-cautious. The matter is now reported to have been taken up at a diplomatic level, and the Minister of Civil Aviation was expected to make a progress report earlier this week.

INDEPENDENT TRIO: Mr. Ludvic Braathen (left), chairman of the Norwegian independent airline, acted as host at a meeting—held in Oslo last week—of the management committee of F.I.T.A.P. (the International Federation of Independent Air Transport). Pictured with him are A.Cdre. G. J. Powell (centre), chairman of the Federation and of B.I.A.T.A., and Mr. J. Eric Rylands. A. Cdre. Powell is managing director of Silver City Airways, and Mr. Rylands of Skyways and Lancashire group. Other independents at Oslo included Fred Olsen Airtransport, T.A.I. and U.A.T.

ADMIRALS BRIEFLY GROUNDED

THE entire fleet of 27 Admiral-class Vikings used by B.E.A. on domestic and international routes were grounded on Friday, April 24th, when the possibility of passenger seats becoming loose was discovered. Apparently the rivets joining the two channel-section members which retain seats in position were too short; the corrective action consisted of drilling new holes and fitting longer rivets. The problem was tackled energetically by B.E.A. engineers at London and Renfrew, and by Monday all but one of the aircraft were back in service. Vikings and Pionairs stood-in for Admirals during their temporary absence, and no flights were cancelled. The occurrence was the subject of an altogether disproportionate degree of publicity in several London newspapers.

U.A.T.'S COMET SERVICES

AS shown on page 547 of this issue, the French independent company Union Aéromaritime de Transport is now operating scheduled passenger services with its two Comet 1As. In addition to the Paris-Casablanca and Paris-Casablanca-Dakar routes shown on our map, U.A.T. has now opened a third jet service—*via* Casablanca and Dakar to Abidjan. May 19th is now given as the opening date of the French Comet service between Paris and Brazzaville *via* Tripoli and Kano, and a fifth service, linking Paris with Douala, is expected to begin on June 6th. No date has been announced for the inauguration of U.A.T.'s proposed service to Johannesburg by way of Tripoli, Kano, Brazzaville and Livingstone, but it is expected to take place before this summer.

RICKENBACKER ORDERS MORE 1049s

ORDERS for Lockheed 1049 Super Constellations have now reached a total of 111 aircraft, additional to the 210 earlier-type "Connies" which have been built. The latest order—for six compound-engined 1049Cs—has been placed by Capt. Eddie Rickenbacker, president of Eastern Air Lines. His company is already operating 30 Super Constellations. Another order for six of the lengthened Lockheeds has been placed by Northwest Airlines as the first step in a new re-equipment programme.

B.E.A.'S VISCOUNT AND ELIZABETHAN ROUTES

DURING the period April 17th-24th British European Airways introduced new equipment on a number of routes. Viscounts were introduced for the first time on sustained service when on Saturday, April 18th, G-AMNY *Sir Ernest Shackleton* left London Airport at 0832 hr G.M.T. for Rome, Athens and Nicosia. The crew consisted of Capts. A. S. Johnson and A. Wilson, R/Off. J. Whitaker, Steward L. Melton and Chief Stewardess Pamela Rome. On the following day, Viscounts took over operation of the London-Rome-Athens-Istanbul route, the first service being operated by G-ALWE *Discovery*, with Capt. E. A. Turner in command. The third Viscount route was inaugurated on April 25th by G-ALWE *Discovery* (Capt. M. D. S. Hood) when it left London for Zürich.

Introduction of Viscounts released Elizabethan-class aircraft for other duties and the following inaugural flights took place: London-Manchester, G-AMAC *Sir Robert Cecil* (Capt. A. R. Marks); London-Amsterdam, G-ALZX *Sir John Norris* (Capt. P. Bray); London-Brussels-Düsseldorf, G-AMAF *Lord Howard of Effingham* (Capt. J. R. Turner); London-Amsterdam-Hanover, G-ALZT *Sir John Hawkins* (Capt. A. N. Hadley); London-Amsterdam-Hamburg, G-ALZX *Sir John Norris* (Capt. P. G. F. Fletcher); and London-Frankfurt-am-Main, G-ALZY *Sir Philip Sidney* (Capt. I. R. Harvey). With the exception of that serving Manchester, all these Elizabethan services opened on April 19th.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

One of the Fox Moths mentioned below.

Heavy Fuels for Gas Turbines

YOUR summary (*Flight*, April 10th) of the article, *Heavy Fuels for Turbines*, which appeared in the March number of *Shell Aviation News* raises several interesting points.

The use of diesel fuel, with its initial cloud-point around 0 deg C. does, as you suggest, raise certain complications, and this aspect has received some consideration in a study made of the operation of a Nomad-engined aircraft with this fuel.

The conditions which would occur in flight do suggest that some form of fuel heating would be required, but in the case of the Nomad the problem is of considerably smaller dimensions than that for the jet engine, for two reasons. Firstly, we would be using a circulating fuel system, which would ensure circulation of fuel through the tanks at a rate two or three times that of the engine demands. Secondly, the Nomad engine has coolant and oil radiators and a simple heat-exchanger of small dimensions would be quite sufficient to provide any additional heating not already supplied by the circulating fuel system.

Incidentally, it does not seem feasible to "freeze" the fuel before use so as to remove the wax, because this would merely result in the composition of the fuel being changed to, say, a kerosine or a gasoline, dependent on the treatment given.

Apart from the above arguments, the fact that the Nomad-engined aircraft would cruise at about 30,000ft, compared with the jet aircraft cruising at 40,000ft, would also reduce the magnitude of the problem somewhat, although it is admitted that some of the apparent benefit would be lost, due to the higher temperature-rise from skin-friction in the case of the jet aircraft (by reason of its higher cruising speed).

The other problem which occurs with diesel fuel is the need to keep aircraft tanks (and, particularly, fuel feed pipe-lines) warm when the aircraft is parked out under Arctic conditions.

One solution which appears practicable would be to extend the engine-heating arrangements to cover the fuel feed pipe also—this pre-supposes that an engine-heater would be used to ensure satisfactory cold starting. Alternatively, the fuel-feed pipe could be heated electrically, provided some ground equipment, in the shape of a motor-generator set, was available.

In our opinion, a satisfactory solution to the use of diesel fuel under low-temperature conditions can be found, without material sacrifice in performance.

D. NAPIER AND SON, LTD.,
London, W.3. C. D. Carmichael,
Asst. Chief Engineer, Piston Engine Division.

Ageless Fox Moths

WHILE re-reading the January 2nd issue of *Flight*, my attention was again drawn to reader Drinkwater's letter on D.H. old timers, which has prompted this letter. It concerns another stalwart of that family—the old Fox Moth.

Ever since 1936 or thereabouts, on my visits to Southport during the summer (barring war-time), I can't ever remember failing to see G-ACEJ "on the beat," pleasure flying—just about the most evergreen aeroplane I've had the satisfaction of knowing, especially considering I was no more than a tender 10 or 11 years of age when I first noticed it. But what gave me the greatest surprise and biggest kick was the arrival last summer of a second Fox Moth, G-ACCB, which from then on shared with 'EJ the heavy flying programme demanded for the remainder of the "season." They are both in fine condition, and watching these great little machines using the expanse of foreshore for their natty take-offs and landings puts one in quite an old-world atmosphere.

I believe these two are the only remaining Foxes to be found in the British Register.

Liverpool, 18. A. W. JESSE.

Commercial Tip-Tanks?

THE tip-tanks of the Cessna 310 (*Flight*, March 27th, 1953, page 413) are a feature I have for some time thought would be ideal in a Rapide replacement. The installation appears to have three great advantages. The aerodynamic advantage of higher effective aspect-ratio with reduced induced drag and more lift; and extra space permitting retraction of the undercarriage into the wing—these you have mentioned, but there appears to be another.

If the aircraft can equal the record of safety of the Rapide, very few will crash, but if a crash does occur, a fire risk is present, whether the aircraft has piston or turbine engines, and the tip tank appears more vulnerable than one integral with the wing. It would be interesting to learn how many fighters in crashes catch fire because of external tanks, particularly the ventral tank of the Meteor, which seems to make a belly landing fatal unless jettisoned in time. Similarly, with all fuel in the tip tanks, although it is as far as possible from the fuselage, an exploding tank will almost certainly envelop the cabin; but if these tanks are jettisonable, they could, when the aircraft is not over populated areas, be dropped when a forced landing was imminent, to do their napalm act at a safe distance from the aircraft.

Cambridge. MORRIS J. CATHERWOOD.

INDUSTRY IN BRIEF

The Goodyear Tyre and Rubber Company's aviation division have recently instructed Heenan and Froude, Ltd., of Worcester, to design and build a large test-plant for aircraft wheels and tyres in their factory at Wallasey, Cheshire.

* * *

Dexion, Ltd., manufacturers of Dexion slotted angle material for works equipment and structural purposes, have opened a Scottish office at 20 Renfrew Street, Glasgow.

* * *

Wallington Weston and Co., Ltd. (incorporating Frome Plastics, Ltd.), of Frome, Somerset, have appointed Mr. J. C. Houghton as their Northern and Midland representative, with offices at 8 Gordon Road, West Bridgford, Nottingham.

* * *

Sheepbridge Engineering Ltd., Chesterfield, announce that, following the transference of their group sales office from London to Chesterfield, Mr. M. M. Hallett (formerly research and development manager) has been appointed director of sales with the object of ensuring complete technical service to customers.

* * *

Chamberlain Industries, Ltd., Staffa Works, London E.10, provide details of their prefabricated aluminium buildings, the sizes of which range from 30ft to 56ft spans, with wall heights of from 12ft to 15ft. Length is in multiples of 10ft, and over 75 per cent of the structure is in standard components.

* * *

A new technical publication by the Northern Aluminium Co., Ltd., Banbury, Oxon, is entitled: *Noral Sheet Products—Part I*, and gives the size limits and manufacturing tolerances for the sheet and plate produced by the company. This information was previously contained in *The Noral Handbook, Section* 3; manufacturing limits have since been considerably extended, and the new book provides current data in a convenient form.

* * *

In a recent reference to Marconi radio equipment (in "Thoughts on the Gnat," p. 426, April 3rd) it should have been made clear that the ground equipment mentioned is the AD. 200; the AD. 7092A is actually airborne equipment.

FORTHCOMING EVENTS

May 7. Pathfinder Association and Club: Annual Dinner.
May 9-10. Aéro Club du Finistère: Brest and Côte des Légendes Rally.
May 13. R.Ae.S. Chester Branch: Annual General Meeting.
May 14-17. American Helicopter Society: Forum, Washington.
May 14-22. F.A.I.: 46th Annual Conference, The Hague.
May 16. Wolverhampton Aero Club: Goodyear Trophy Race and Display.
May 20. Aircraft Recognition Society: "Supersonic Flight Problems," by Prof. A. A. Hall, M.A., F.R.Ae.S.
May 21. R.Ae.S.: All-day Meeting on Aeronautical Acoustics (jointly with the Acoustics Group of the Physical Society).
May 23-25. Aéro-Club d'Epernay: Champagne Rally.
May 23. Derby Aero Club: Display.
May 25. S.S.A.F.A.: Display, Yeadon.
May 25. Air Display, Elmdon, Birmingham.
May 25. Women's Junior Air Corps: Display, White Waltham.
May 29. R.Aux.A.F.: Officers' Coronation Ball, London.
May 30. Auster Flying Club: Ragosine-Auster Homing Trophy.
May 30. Swansea and District Flying Club: Display and Race.
June 5-7. Yorkshire Aeroplane Club: International Rally.
June 6. Leicestershire Aero Club: Coronation Air Display.
June 7. Aero-Club d'Italia: Rome Grand Prix.
June 11. R.Ae.S.: Ninth British Commonwealth and Empire Lecture, "Problems in Development of Air Transport in West Africa," by Sir Hubert Walker, C.B.E.

"Flight" photographs

THIRTY-NINE YEARS ON: Sir Charles Longcroft, the unit's C.O. in 1914, inspecting No. 1 Squadron at Tangmere before making the presentation—shown on the right—of the first Squadron Standard.

SERVICE AVIATION

Royal Air Force and Naval Aviation News

PRESENTATION OF THE FIRST SQUADRON STANDARD

IN weather reminiscent of the days of the Battle of Britain—with con-trails high in the blue sky to heighten the effect—No. 1 Squadron paraded at Tangmere on Friday last to receive the first of the Sovereign's Standards to be presented to a squadron.

The presentation was made by A.V-M. Sir Charles Longcroft, who was the commanding officer of No. 1 Squadron in May, 1914. On arrival Sir Charles was greeted by Air Marshal Sir Dermot Boyle (the newly-appointed A.O.C-in-C. Fighter Command) and A.V-M. the Earl of Bandon (A.O.C. No. 11 Group).

Against a background of the squadron on parade and 10 Meteor 8s and one Meteor 7 glistening in the spring sunshine, and facing the squadron headquarters (in temporary buildings replacing those lost in the Battle of Britain), the new Standard was uncased and laid on the piled drums. Attended by S/L. R. B. Morison, who came from C.F.S. six months ago to command No. 1 Squadron, Sir Charles Longcroft inspected the parade which, in both bearing and drill, was a credit to the Service.

At the end of the inspection the Standard was consecrated by the Reverend A. S. Giles, the new Chaplain-in-Chief of the R.A.F. In this perfect setting the familiar words lost none of their sincerity: "May this Standard never be unfurled except in the cause of righteousness." As the Chaplain gave the last words of the Blessing the Standard-bearer and escort marched up to the piled drums, the bearer, F/O. M. R. T. Chandler, kneeling to receive the Standard from Sir Charles.

The presentation having been made, the Standard bearer turned and faced the parade while Sir Charles addressed the assembly. He spoke of the early days when No. 1 Airship Squadron had become No. 1 Aeroplane Squadron R.F.C., and of how anyone should be proud of ever having belonged to a unit such as No. 1 Squadron, which had served with distinction through two world wars and won 24 battle honours. He concluded by telling the parade that the Standard would be an object of pride for the future and a constant reminder of gallantry in the past. The General Salute was then sounded as the Standard was marched to its appointed position in front of the parade.

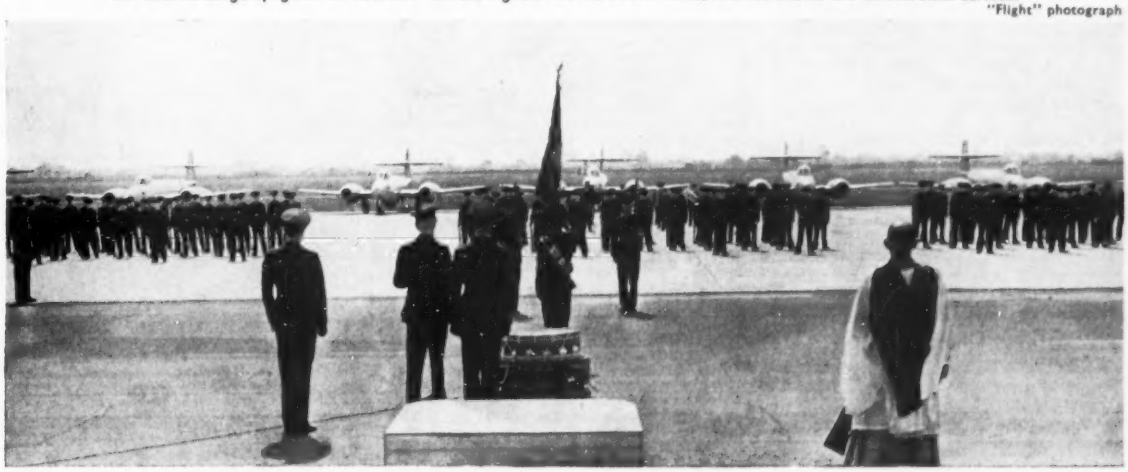
The ceremony ended with the march past in slow and quick time and the advance in review order. As the Standard was marched off the parade ground sufficient breeze blew up to extend the flag and display it in all its beauty. A fitting end to an impressive ceremony.

The award of a ceremonial flag (to be known as the Standard) to operational squadrons of the Royal Air Force which had been in existence for 25 years or had earned the Sovereign's appreciation because of specially outstanding operations, was announced by His Late Majesty King George VI in 1943, on the 25th anniversary of the formation of the R.A.F.

Squadrons to which it was then an-

SQUADRON CEREMONY: The scene on the apron at Tangmere last Friday. The newly presented Squadron Standard is facing the parade while Sir Charles Longcroft gives his address. On the right is the Rev. A. S. Giles, who conducted the consecration service.

"Flight" photograph



SERVICE AVIATION . . .

nounced that the award had been made were Nos. 1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 14, 20, 24, 25, 27, 28, 30, 31, 39, 45, 47, 55, 56, 60, 70, 84, 100, 207, 208 and 216 Squadrons of the Royal Air Force, and to these were added Nos. 9, 10, 13, 15, 16, 17, 19, 22, 23, 26, 29, 32, 33, 41, 43, 58, 99, 101, 111, 201, 202, 203 and 205 Squadrons as also being qualified by length of service. Together with No. 2 Armoured Car Squadron and Nos. 502, 600, 601, 602 and 603 Squadrons of the Royal Auxiliary Air Force and Nos. 120 and 617 Squadrons R.A.F. which, though they had not been in existence for 25 years, had earned His Late Majesty's appreciation for specially outstanding achievements in operations. Many of the long-service Squadrons which have received the award would otherwise doubtless have qualified because of their operational records.

The Standard is a rectangular silk flag with the squadron badge centred on a light blue background. The flag is fringed and tasselled, with scrolls added for recording battle honours.

The battle honours to which each squadron is entitled are being notified to them by Command Headquarters. The maximum number of battle honours which can be shown on the scrolls to the standard is eight, and a squadron entitled to more than this number must select the battle honours to be commemorated in this way. Out of the 24 honours to which it is entitled, the battle honours selected by No. 1 Squadron are: Western Front, 1915-1918; Ypres, 1915; Independent Force and Germany, 1918; Somme, 1916; France and Low Countries, 1939-1940; Battle of Britain, 1940; Fortress Europe, 1941-1944; France and Germany, 1944-1945.

The Duke Flying Twins

IT is announced that the Duke of Edinburgh has begun training on twin-engined aircraft. An Airspeed Oxford is housed at White Waltham for his personal use. Instruction on the Oxford should complete the Duke's flying training and he will then have earned his wings in precisely the same manner as any other *ab initio* student pilot.

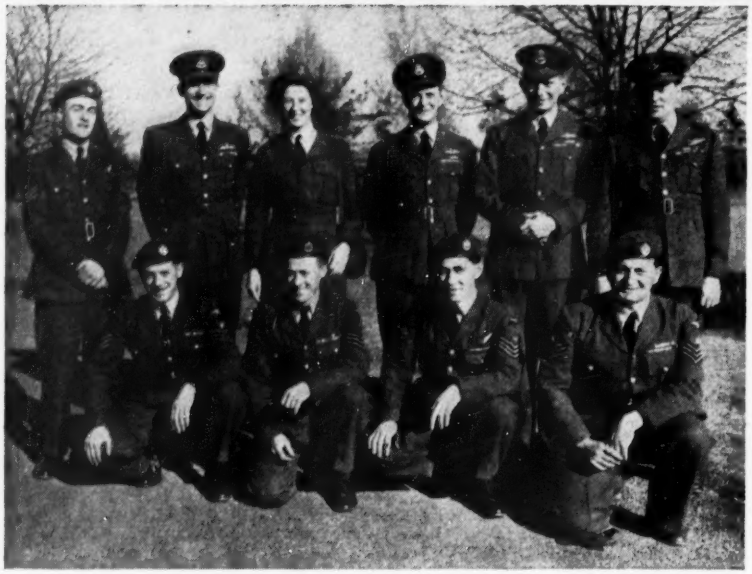
Sir Charles Lambe

WE regret to announce the death of A.V-M. Sir Charles L. Lambe, who retired from the R.A.F. in 1931. He will be remembered mostly as the officer who commanded the R.N.A.S. units of the Dover Patrol from August 1915 until nearly the end of the war in 1918. In 1924 he was in command of No. 1 School of Technical Training, Halton, and in 1928 took over Coastal Area.

St. Clement Danes Church

ONE of the provisions in the scheme for the ecclesiastical reorganization of Westminster parishes is that the parish of St. Clement Danes shall be united to that of St. Mary-le-Strand and that, following restoration, St. Clement Danes shall be appropriated, under conditions agreed with the Air Council, for use as a church for members and former members of the Royal Air Force and associated forces.

The Air Council has appointed a committee, of which Marshal of the R.A.F. Sir John Slessor is chairman, to advise on matters connected with the restoration of the church, and the committee has begun its task. It is intended that the Royal Fine Arts Commission shall be consulted.



THE CREW OF WJ338: (back row, left to right) Sgt. J. W. Leeming, F/L. P. I. Badley, Flt/O. J. S. Weir, W/C. E. B. Harvey, F/L. P. E. Pullan (captain), F/L. E. T. Orringe; (front row) F/Sgt. R. E. Houston, Sgt. R. S. Tooke, Sgt. J. N. Fulker, F/Sgt. D. L. Bourke.

A HASTINGS THROUGH THE IRON CURTAIN

Continued from page 531

went out to the aircraft and were told what they wanted to know about the instruments and equipment. They appeared to the crew to be very quick in familiarizing themselves with the Hastings equipment and instruments.

On the exact E.T.D. of noon the Hastings took off with the two Russians from Aeroflot standing in the cabin gangway. Once airborne, the Russian navigator gave F/L. Pullan a course which, like all other information, was passed as figures on a writing pad. Where an explanation of a figure was needed gesticulations were employed. Wind speed was accompanied by a puff of the cheeks; for types of cloud formations the shape was indicated by the hands; and figures, when not written, were transmitted by showing the appropriate number of fingers. Place-names were spoken as the Russian navigator wrote them down, but otherwise no words passed.

The Hastings had reached its cruising height of 10,000ft by Frankfurt-on-Oder and crossed the Polish border exactly on time. The course continued due east to Warsaw along the corridor which other Transport Command aircraft use on a regular service to the Polish capital. Continuing east until within seven miles of Siedlce, F/L. Pullan was given a new course due north to Lyck, where another change was made to a N.E. track which took the Hastings across the Polish border and along to Vilna, the Lithuanian capital. Russia was entered near—appropriately—Pilotsky and the course was again given, due east. North of Vitebsk the Hastings captain was directed south-east and on this course the aircraft was brought to a point some 25 miles S.S.E. of Moscow, where instructions were given for the landing. For some 90 minutes the aircraft had flown in 8/8ths stratus but half-an-hour from the destination conditions improved and the flight was completed with a visibility of two to three miles. The Hastings turned towards Vnukovo, Moscow's civil airport, at 6,000ft, the navigator giving the pilot the type of circuit to fly and the setting in millibars. In spite of a fairly strong cross-wind the Hastings made a comfortable landing. Taxying instructions were passed by the Russian operator and, no doubt to the surprise of many at the airport, an aircraft with R.A.F. roundels came to a halt in front of the main terminal building.

The flight had taken 5 hr 40 min, nearly an hour longer than had been expected, the detour adding some 200 miles to what would otherwise have been a flying distance of 900 miles.

There was a lot to do at the airport and, owing no doubt to the unusual nature of the flight, it was some hours before the R.A.F. party could be taken to their hotel. The British Embassy had arranged for accommodation at the National Hotel and on the way from the airport they passed through Red Square. Although it was after 2200 hr there were still crowds gathered around the mausoleum outside the Kremlin walls. Meals in Moscow are protracted affairs—and on special occasions extremely so. The R.A.F. visitors were taken to a famous Georgian restaurant where the Embassy entertained them to a full Russian dinner, including the inevitable caviare and vodka. W/C. Harvey had still to be briefed by the Embassy doctor on the physical state of the passengers, and when he got to bed at 0330 hr he had been on the go since he was called at Lyneham more than 24 hours earlier. Flt/O. Weir had the most palatial suite in the hotel; like the other rooms and even the reception hall at the airport, it was richly and ornately furnished in almost Victorian style.

The 20-mile drive out to the airport, mostly over a very indifferent road, took more than an hour. The Hastings was filled up with 3,800 litres of fuel, to which the Hercules engines took very kindly on the way back to Berlin. The Russian navigator and wireless operator rejoined an hour before E.T.D. and agreed to the suggestion that, for the comfort of the passengers, the flight should be made at a lesser height, namely, 7,000ft. The Aeroflot ground crew were most helpful in every way; the reception staff—Russian girls in navy-blue uniforms with silver epaulettes and brown high-heeled shoes—were attentive, and the met. information (again provided by a feminine staff) proved very accurate on the flight over Russia.

The passengers arrived at the airport accompanied by the British Ambassador and Lady Gascoigne and a host of British and Russian officials. Two of the seven made use of two of the four stretchers set up in the Hastings during the flight and all of them were soon made comfortable by Flt/O. Weir. The last formality inside the aircraft was the return of passports, which had to be delivered up on arrival at the hotel and at the airport. The Russian marshaller gave the captain a thumbs-up sign to start taxying and the Hastings was soon airborne and heading off on a reciprocal course to the outward flight. Frontal conditions, with icing, were again experienced on the return and the aircraft was in cloud for some minutes of the journey. The journey to the Royal Air Force station at Gatow was made in 5 hr 20 min.

There friendly handshakes were exchanged between the British and Russian aircrew and although F/L. Pullan's thanks were expressed in English there was little doubt that they were understood. S/L. Poulter prompted F/L. Badley in the Russian word for "Cheerio," which, when called out to the Aeroflot crew, brought a broad smile of recognition and a friendly wave. And it was on that happy note that this rare Anglo-Russian co-operation in airmanship ended.

E. S.
ASTON
& CO. LTD.

MACHINISTS OF PLASTICS

(APPROVED BY A.I.D. & A.R.B.)

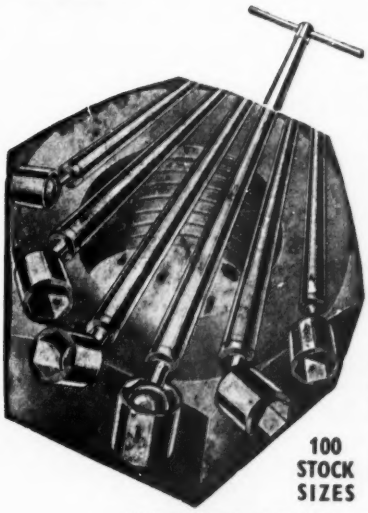
Suppliers of Machined Plastic parts for the D.H. Comet

5, SEBASTIAN STREET, LONDON, E.C.1

Phone Clerkenwell 2179

Leytool

UNIVERSALLY JOINTED
SOCKET SPANNERS
For
ASSEMBLY and MAINTENANCE
OF JET AND TURBINE ENGINES



100 STOCK SIZES

Originally devised for war-time service on aero engines. Manufactured to close limits of accuracy. Moving parts of specially hardened alloy steel.

Write for fully descriptive leaflet and complete catalogue of "Leytool" Hand Tools

THE LEYTONSTONE JIG & TOOL CO., LTD.

LEYTOOL WORKS, HIGH ROAD, LEYTON, LONDON, E.10 *Phone: Leytonstone 5022-3*

Ceiling by Comet . . . . .

Sealing by . . .

Bostik

The integral fuel tanks in the Comet are sealed with special Bostik products.

Bostik is a registered trademark of the B.B. Chemical Co., Ltd., Leicester, Adhesive Engineers to the Aircraft Industry.

B. B. CHEMICAL CO., LTD., ULVERSCROFT ROAD, LEICESTER

for all ANGULAR drives...

UNIVERSAL JOINTS

. . . provide the most efficient compact and powerful answer

ME Joints are manufactured under ideal conditions, by specially designed single purpose plant. Rigid inspection of components is made after each operation, and heat treatments are scientifically controlled.

Catalogue on request.

THE MOLLART ENGINEERING CO. LTD.

KINGSTON BY-PASS - SURBITON - SURREY
Phone: ELMbridge 3352-3-4 Telegrams: Precision, Surbiton
AIR MINISTRY GAUGE TEST HOUSE AUTHORITY
89755/31

'ME' PATENT UNIVERSAL BALL JOINT

Combines high load carrying capacity, simplicity of design and utmost reliability. 92%—98% efficient (N.P.L. certified).

HOOKE'S TYPE UNIVERSAL JOINT

Suitable for high speeds. Inexpensive to fit and needs no telescoping sleeves. Will stand some tension and compression loads.

HOOKE'S TYPE LIGHT SERIES **UNIVERSAL JOINT**

Designed for light duty. Moderate tension and compression loads are allowable.

Protect for life with 'ME' Grease Retaining Covers
Available for all types and sizes of joints

HABERSHON STEEL STRIP
is used in the *'COMET'*
and in most of the World's leading aircraft

We make no extravagant claims when we state that the World's leading aircraft manufacturers have, for many years taken advantage of our knowledge and experience in the production of Steel Strip, Sheets and Sections. Can we help you ?

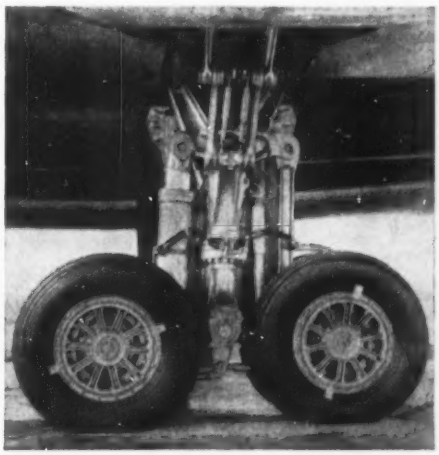
Habershon STEEL STRIP
meets the most *exacting* requirements

J. J. Habershon & Sons Ltd., Rotherham. Telephone 2081 (6 lines)

51 tons of the world's first jet airliner touches down safely and smoothly with the help of . . .

DUNLOP

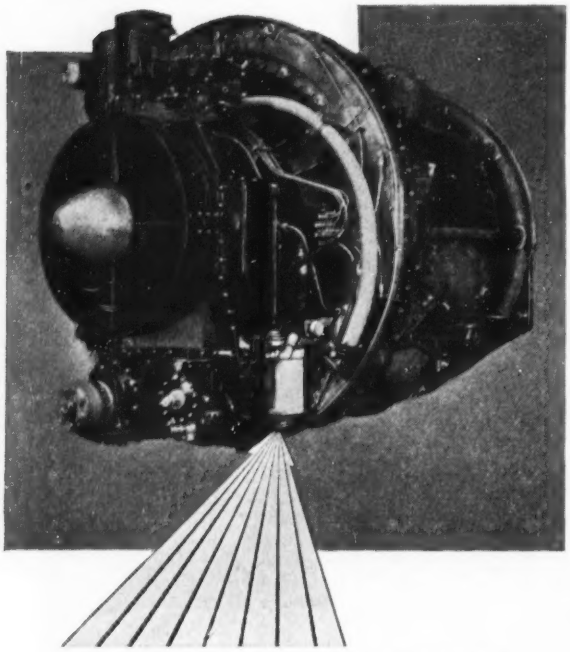
Tyres Wheels Brakes and Flexible Pipes



DUNLOP RUBBER CO. (AVIATION DIVISION)
FOLESHILL · COVENTRY

2H/603

Vokes Fuel Filter fitted to the Ghost engine of the D.H. Comet.



VOKES FILTERS SHARE IN ANOTHER PAGE OF AERONAUTICAL HISTORY

From the early days of war-time desert flying, in which VOKES filters so dramatically proved the vital importance of scientific filtration in aeronautical practice, VOKES filters have been closely linked with every major development. Fitted to the first Whittle jet engine . . . specified to assist in stratosphere-level cabin pressurization problems . . . chosen for the majority of aircraft in production today . . . these are but a few of the recent VOKES landmarks.

VOKES

Pioneers of scientific filtration

VOKES LIMITED · GUILDFORD · SURREY

Represented throughout the world

VOKES (CANADA) LTD., Toronto. VOKES AUSTRALIA PTY., LTD., Sydney.

MAKE IT A *Jubilee*

Coronation Year

Famous in Four Reigns

L. ROBINSON & CO. (GILLINGHAM) LTD.
London Chambers, GILLINGHAM, KENT. Phone 5282

OIL
PETROL &
WATER
RESISTING

NEO-K-TEX

Jointing Material

GASKETS
WASHERS
SHEETS &
MOULDINGS

KAUTEX LTD

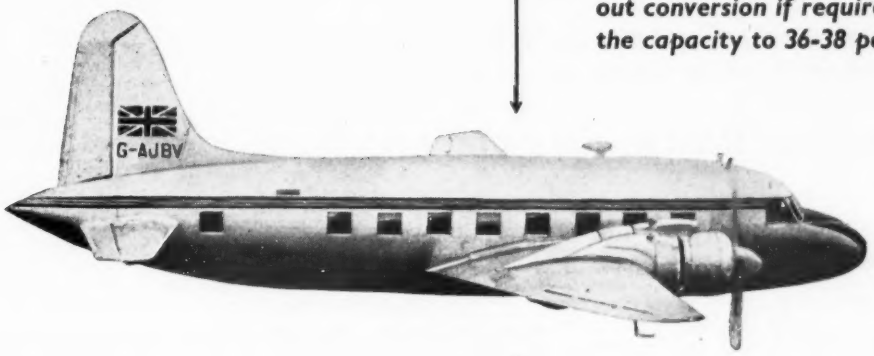
ELSTREE WAY, ELSTREE, HERTS
TELEPHONE: ELSTREE **1777-8-9**

FOR YOUR IMMEDIATE ATTENTION . . .

Aviation Servicing, Limited, have purchased a number of Vickers Viking Mark 1B aircraft from British European Airways.

These aircraft are now OFFERED FOR SALE either singly or in fleet units, together with spares and ground equipment. Hire Purchase terms will be considered, also part purchase, part leasing arrangements.

The aircraft are the long-nose, metal-wing version of the Vickers Viking and, whilst at present equipped to carry 27 passengers, Aviation Servicing will undertake to carry out conversion if required, to increase the capacity to 36-38 persons.



Vickers Viking aircraft are of proven reliability and have been operating on the European routes with great success.

BRIEF SPECIFICATIONS

ENGINES
Bristol Hercules 634 fitted with all modifications to latest Bristol Aeroplane Co. standard.

PROPELLERS
ROTOL R44/456/4. Hydraulic, 4-bladed, metal.

ELECTRICAL SYSTEM
24-volt d.c. generators: Type 02, 30 volt, 3,000 watts.

ACCOMMODATION
Crew: 3 and steward. Passengers: 27 in separate non-adjustable chairs (9 in forward cabin and 18 in aft cabin). Galley, toilet and coat space at rear.

RADIO
MF/HF. W.T. T.1154. R.1155. V.H.F. STR 12A/1 23-channel. S.C.R. 269G. ADF equip. ARI.5083. Gee. ILS. C.B.A. Etc.

AVIATION SERVICING LTD.

Head Office

29 CLARGES STREET

LONDON, W.1.

Telephone Grosvenor 6411

Ratcliffe Tool Co. Ltd.
are proud to have been of assistance to
de Havilland Aircraft Co. Ltd.
in the Production of the Comet

RATCLIFFE TOOL Co LTD

Designers and Manufacturers of

JIGS, FIXTURES, PRESS TOOLS, MOULDS AND DIES, GAUGES AND SPECIAL PURPOSE MACHINES

GORST ROAD, PARK ROYAL, LONDON, N.W.10

TELEPHONE: ELGAR 6693

NEWTON-DERBY

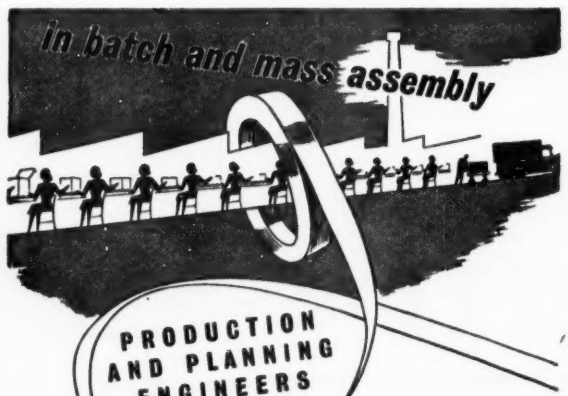
AUTOMATIC
VOLTAGE REGULATORS

Also makers of Rotary Transformers and Anode Convertors, Wind- and Engine-Driven Aircraft Generators, High-Frequency Alternators and High Tension D.C. Generators

ELECTRICAL PLANT SPECIALISTS

NEWTON BROTHERS (DERBY) LIMITED

HEAD OFFICE & WORKS, ALFRETON ROAD, DERBY
TELEPHONE: DERBY 47474 (3 LINES) TELEGRAMS: DYNAMO, DERBY
LONDON OFFICE: IMPERIAL BUILDINGS, 56 KINGSWAY, W.C.2



PRODUCTION AND PLANNING ENGINEERS use

Gosheron TAPES

A.I.D. and G.G.I. Approved

to fasten, protect, mask, identify, instruct, strengthen—and in packaging, to seal securely and attractively

Let us send you samples—may we?

JOHN GOSHERON & CO LTD GAYFORD ROAD LONDON W12

"Say it with TAPE—clearly quicker"

The link between...

Looking up at the airliner as it passes, the farmer would never guess that there was anything in common between ploughing a field and travelling across the sky at 400 miles an hour. Yet both his tractor and the aircraft must depend to some extent upon the reliability of Oldham Batteries and both farmer and pilot know that you can't beat Oldham Batteries when it comes to giving efficient service under a wide variety of conditions.

OLDHAM

POWER TO SPARE

AIRCRAFT BATTERIES

OLDHAM & SON LTD · DENTON MANCHESTER · EST. 1865

AVIATION TRADERS
Limited

Our A.R.B. Approved Bonded Stores at
SOUTHEND and STANSTED AIRPORTS IN ESSEX
carry among the largest stocks of
Airframe, Engine and Ancillary Spare Parts
in this country.

We offer the following selections of Eclipse Starter Spares:

EA 12988	Gear Assembly
EA 19897	Bracket Insulator Assembly
EA 19898	Switch Main
EA 22665	Plate Ring
EA 25125	Ring
EA 26524	Housing
EA 26761	Coil
EA 27773	Plate
EA 32861	Plate Assembly—Starter Switch
EA 37651	Gear
EA 48878	Bracket with Mounting
EA 49107	Housing
EA 49119	Gear Ring
EA 49139	Retainer
EA 51531	Vent Line
EA 52484	Box Junction
EA 73761	Cover
EA 80330	Cover Plate End
EA 80337	Insulator Block
EA 80493	Ring Gear
EA 80579	Plates
EA 86871	Plate
EA 90336	Gear
EA 90453	Insulator
EA 90842	Plate Generator
EA 91149	Plate Pole
EA 91272	Gear
EA 94795	Coupling
EA 102613	Gear and Shaft Assembly
EA 104743	Starter Top Bracket
EA 107433	Condenser 200 VDC
EA 108325	Cover Ring
EA 11836	Cover Ring
EA 108325	Spacer
EA 17772	Dog Starter

We are prepared to offer quotations for the following: 6B/216. Suspension Sextant for Somes observation. Large quantities available.

SALES DEPARTMENT
15, Great Cumberland Place, LONDON, W.1

Telephone: AMBassador 2091 (5 Lines) *Cables:* "AVIATRADE LONDON" *Telegrams:* "AVIATRADE WESDO LONDON"

It has been our privilege to supply

STAINLESS STEEL BARS

for the

DE HAVILLAND "COMET"

STAINLESS STEEL AND HEAT RESISTING BARS
BLACK, BRIGHT DRAWN OR SMOOTH GROUND
HEAT TREATED OR ANNEALED

SPECIFICATIONS:
DTD 13B, DTD 49B, DTD 176A, DTD 525, S61, S62, S80

C. G. CARLISLE & CO. LTD.,

629, PENISTONE ROAD, SHEFFIELD, 6 *Telephone Sheffield 43615*

R. M. R.

ENGINEERING
TRING, HERTS.

Phone 3338

Contractors to H.M. Govt.
and leading Aircraft
Constructors

A.I.D. and A.R.B. Approved

MAKERS OF THE ROD END BEARINGS AND A WIDE RANGE OF A.G.S. PIPE LINE COUPLINGS AND UNIONS USED ON THE DE HAVILLAND "COMET"

We can offer keen prices and good deliveries, some from stock.

G4

Suppliers of machined and fabricated components in all Plastic and Allied materials to Britain's aircraft industry

Telephone: CLERKENWELL 2333/4 & 7247 — UHLHORN BROS. LIMITED — Telegrams: UHLHORN, AVE, LONDON

ESTD. 1887

We are proud to have the pleasure of supplying our precision products to many of the leading British aircraft constructors

UHLHORN BROS. LTD.
53 CITY ROAD, LONDON, E.C.1

ENGINE AND CHASSIS DESIGNERS

URGENTLY REQUIRED

GOOD PROSPECTS FOR THE RIGHT TYPE OF APPLICANT

SALARY ACCORDING TO AGE, QUALIFICATIONS AND EXPERIENCE

APPLY IMMEDIATELY TO:

PERSONNEL MANAGER

ROLLS-ROYCE LIMITED
PYM'S LANE, CREWE

FLIGHT and AIRCRAFT ENGINEER

PRESS DAY — *Classified advertisement "copy" should reach Head Office by* FIRST POST THURSDAY *for publication in the following week's issue subject to space being available.*

CLASSIFIED ADVERTISEMENTS

Advertisement Rates. 4/- per line, minimum 8/-, average line contains 6-7 words. Special rates for Auctions, Contracts, Patents, Legal and Official Notices, Public Announcements, Tenders 5/- per line, minimum 10/-. Each paragraph is charged separately, name and address must be counted. All advertisements must be strictly prepaid and should be addressed to FLIGHT Classified Advertisement Dept., Dorset House, Stamford Street, London, S.E.1.

Postal Orders and cheques sent in payment for advertisements should be made payable to Iliffe & Sons, Ltd., and crossed & Co.

Trade Advertisers who use these columns regularly are allowed a discount of 5% for 13, 10% for 26 and 15% for 52 consecutive insertion orders. Full particulars will be sent on application.

Box Numbers. For the convenience of private advertisers, Box Number facilities are available at an additional charge for 2 words plus 1/- extra to defray the cost of registration and postage, which must be added to the advertisement charge. Replies should be addressed to "Box 0000, c/o Flight," Dorset House, Stamford Street, London, S.E.1.

The Publishers retain the right to refuse or withdraw advertisements at their discretion and do not accept liability for delay in publication or for clerical or printer's errors although every care is taken to avoid mistakes.

Situations Vacant. The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service etc. if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

LAMBERT BROTHERS

are instructed to offer for sale this

SHORT SEALAND AMPHIBIAN

● **SEATING:** Pilot, Radio Officer and six Passengers.

● **RADIO EQUIPMENT:** Marconi AD. 97. HF/AD 108—Marconi AD. 7092—Standard STR. 9X.—H.F/VHF equipment—A. D/F equipment. 24 volts.

● **CONDITION:** Engine Hrs. Starbd. 70.15. Port 69.25. Airframe Hrs. 426 hrs. 15 mins. Propeller Hrs. Starbd. 66 hrs. 30 mins. Port 66 hrs. 30 mins.

● **FULL INSTRUMENT AND NIGHT FLYING EQUIPMENT**

Aircraft can be inspected by appointment at Croydon Airport

IMMEDIATE DELIVERY

LAMBERT BROTHERS LTD.
Cunard House, 88 Leadenhall Street, London, E.C.3

ADCOLA

(Regd. Trade Mark)

SOLDERING INSTRUMENTS
SOUND Joints for SOUND Equipment

Any voltage range supplied 6/7 to 230/250

- Standard model for radio maintenance, etc. Detachable bit type. (Factory Bench Line)
- Equally suited to daily or intermittent use
- Consumption: 25 watts
- Total length of instruments: 9 inches

Made in England Registered Design British, U.S.A., Canadian & Foreign Patents

● *Apply Sole Manufacturers and Suppliers*

ADCOLA PRODUCTS LTD.
Sales, Offices & Works: *MACaulay 4272*
CRANMER COURT, CLAPHAM HIGH ST. S.W.4.

AIRCRAFT FOR SALE

W. S. SHACKLETON, LTD.

CALLING AUSTRALIA!

WE recall with pride that just before the war we discovered, to our surprise and delight, that we had shipped to Australia (including Papua and M.T.N.G.) just over 20% (twenty per cent.) of all—repeat ALL—the civil aircraft registered there.

AS we write this a letter has just arrived from Perth, W.A. It reads:—

"Once again I wish to thank you in your selection of such a fine machine; its general condition is better than your description. It is pleasing to note that, having ordered three Austers from your good selves, each one has been above expectations."

WE now have pleasure in announcing that AVIATION SERVICING, LTD., who have purchased a large number of VICKERS VIKINGS, MARK 1B, from British European Airways, have given us the sole selling rights in Australia for these excellent post-war 27/38 passenger aircraft, which have given such wonderful service with B.E.A. They compare more than favourably with Dakotas in cruising speed, cost per passenger mile and engine life between overhauls.

W. S. SHACKLETON, LTD., also have pleasure in announcing that we have been invited by the world-famous firm of

HENLYS, LTD.
(Europe's leading Automobile Distributors),

to assist in the sale of their mechanical handling and transport equipment in the

BRITISH AIRCRAFT INDUSTRY,

where we have so many clients and friends. Demonstrations and advice will be given gladly and without obligation. The equipment includes:—

BRUSH INDUSTRIAL TRUCKS
WRIGLEY MOTOR TRUCKS,
WRIGLEY FORK LIFT TRUCKS,
TRAILERS,
GIRAFFE ELEVATORS,
ZEPHYR CONVEYORS, ETC.

W. S. SHACKLETON, Ltd., 175 Piccadilly, London, W.1. Tel.: Regent 2448/9. Cables: Shackhud, London. [0070

R. K. DUNDAS, Ltd.

WHETHER you are thinking of starting an airline, running a club or just flying the girl friend, the House of Dundas can help and advise you. We not only supply aeroplanes and accessories, but all types of airport equipment from chocks to hangars. This week we can offer:—

C-47 FREIGHTER
AUTOCARS
AUTOCRATS
GEMINIS
MESSENGERS
PROCTORS

All with new long-term Cs of A. and guaranteed up to Dundas standard.

R. K. DUNDAS, Ltd.

29, Bury Street, St. James's, London, S.W.1. Cables: "Dundassaero, London."

CROYDON AIRPORT. Cro. 7744. Cables: "Dundassaero, Croydon Airport." [0059

AEROSERVICES (LONDON) LTD.

OFFER for immediate delivery:—

PRATT AND WHITNEY engines, Series R.1830-92, fully overhauled and fitted with latest type anti-moisture ignition harness.

STROMBERG carburettors, Type PD-12-H4 and PD-12-F5, fully overhauled and released.

MANY other major components and spares available.

SEND your enquiries to:—

46 HERTFORD STREET, PARK LANE, LONDON, W.1.
Tel.: Grosvenor 8383.
Cables: Aeropaul, London. [0040

£275 Tiger Moth; low hours; current C. of A.

£595 Auster V; full blind flying, etc.

£375 Proctor III; Rumbold upholstery.

VENDAIR, Croydon Airport, Croydon 5777. [0603

AIRCRAFT WANTED

WANTED, Messenger or Gemini.—Full particulars and price to 6, The Avenue, Middlesbrough. [0048

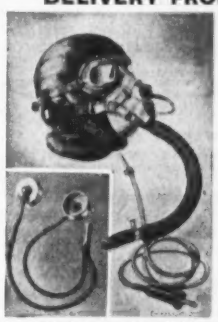
OUR demand for good used aircraft of all descriptions is very great. Operators or owners wishing to dispose of aircraft, engines, or anything aeronautical, are asked to communicate at once to:—

R. K. DUNDAS, Ltd., 29, Bury Street, London, S.W.1.
WHI. 2648. Cables: "Dundassaero, Piccy, London."

CROYDON AIRPORT. CRO. 7744. [0058

FLYING EQUIPMENT

DELIVERY FROM STOCK



FLYING HELMETS Type C & E

MASKS Type C & H

MICROPHONE and INTERCOM-MUNICATION EQUIPMENT of all types

GOSPORT TUBES

24/3

The oldest name for pilots' personal equipment in the country.

Terms to Flying Clubs. Trade Supplied
Send 3d. in stamps for illustrated catalogue.

D. LEWIS LTD. (Dept. F)
Leather Clothing Manufacturers for Home or Export
124 GT. PORTLAND ST., LONDON, W.1
Tel.: Museum 4314 Grams: Aviakit, Wesdo, London

WOLVERHAMPTON AVIATION LTD.

THE LEADING LIGHT AIRCRAFT ENGINEERS

THE AIRPORT, WOLVERHAMPTON
Telephone: Fordhouses 2228

ATTENTION ! ! !

AIR LINE OPERATORS and AIR CHARTER COMPANIES

Do not increase *your* staff to overcome *PEAK OVERHAUL PERIODS*

We have the *Capacity, Staff* and *Means* to help you

ESTIMATES INVITED

LONDON OFFICE: Telephone ABBEY 2345
78, BUCKINGHAM GATE, S.W.1.

AIRCRAFT SPRING WASHERS

TO B.S. SPECIFICATION S.P.47

CROSS MFG. (1938) LTD., COMBE DOWN, BATH

AIRCRAFT ACCESSORIES AND ENGINES

A. J. WALTER.

SPARES held for most types of British and American aircraft and engines. Please forward us your enquiries. Watch this advertisement for details of special bargains.

HEREWITH a few items which can be supplied ex-bonded stores:

3 1,128 Purulator valves.

5 110,586 U/C Retracting jacks.

2 2,097 U/C Compensating jack.

5 117,384 Hydraulic flap jack.

4 143,736 Cowl gill selector.

2 119,018 Flap relief valve.

5 57-2 Check valves.

5 57-3 Check valves.

A. J. WALTER, Gatwick Airport, Horley, Surrey. Cables: "Cubeng, London." Tel.: Horley 1420 and 1510. [0268

AIRCRAFT SERVICING

BROOKLANDS AVIATION, Ltd., Brooklands Aerodrome, Weybridge. C. of A. overhauls, modifications and conversions. Tel.: Byfleet 436. [0305

REPAIRS and C. of A. overhaul for all types of aircraft. —Brooklands Aviation, Ltd., Civil Repair Service, Sywell Aerodrome, Northampton. Tel.: Moulton 3218. [0307

CERTIFIED crack detection by Magna Flux of aircraft parts. Prompt services; reasonable charges.—C. and S. Aircraft, Blackbushe Airport, Camberley 1600 (Extn. 307). [0310

AIRCRAFT WANTED FOR HIRE

WANTED, Auster Autocrat for period. Liberal hire.—Giro Aviation, Ltd., Promenade, Southport. [9565

BUSINESS AND PROPERTY

FOR sale. Cookham Dean. Freehold house, 16 miles Heath Row, Northolt. 3 bed., 2 recep., kit., bath., sep. w.c., double garage. Tel. All services. Price £4,500 o.n.o. —Further particulars Box 6942. [9555

CAPACITY AVAILABLE

ENGINEERS to the trade; rigs and special equipment, jigs, fixtures and press tools, machining and press work.—S. & H. Bryant & Co., 112, High Street, London, N.W.10. Tel.: Elgar 4744. [9550

CARAVANS

NEW "Statesman," £1,065. Other Berkeleys from £399/10/-. New Glider 4-berth de luxe, £399/10/-, and 2-berth, £212. Safari, £368. Towing. Hire purchase.—Mantles Garages, Ltd., Biggleswade. Tel. 2113. [0367

CLOTHING

R.A.F. and R.N. officers' uniforms purchased; large selection of R.A.F. officers' kits for sale, new and re-conditioned.—Fisher's Service Outfitters, 85-86 Wellington St., Woolwich. Tel.: Woolwich 1055. [0567

CLUBS

REDHILL FLYING CLUB.

LEARN to fly at Redhill Aerodrome, Surrey, South London's nearest flying centre, 23 miles from Hyde Park Corner. £3/10/- per hour dual; from £2/10/- solo; instrument flying, instructors' and advanced courses. Attractive clubhouse with full catering facilities.—Tel.: Nutfield Ridge 2245. [0347

LONDONERS! Your most accessible and reasonable flying club. M.C.A. approved. Austers, 45/- hour. trial lesson 17/6.—Phone Penguin Flying Club, Victoria 1300. [0265

HERTS and ESSEX AERO CLUB, Broxbourne Aerodrome, Nazeing, Essex. M.C.A. approved 30-hour course; residential; trial lessons, 35/-; train from Liverpool Street, or Green Line Coach 715. Tel.: Hoddesdon 2453, 2421. [0230

CONSULTANTS

R. W. SUTTON (CONSULTANTS), Ltd., 7, Landsdown Place, Cheltenham. Tel. 5811. [0750

WING COMMANDER R. H. STOCKEN, F.R.Ae.S., Eagle House, 109, Jermyn St., London, S.W.1. Tel.: Whitehall 8985. [0419

MISCELLANEOUS

STEEL lattice and guyed radio masts, 100ft high, for sale. Delivery from stock. Excellent condition.—Bellmans, Terminal House, S.W.1. [9515

HANGARS

HANGARS FOR SALE (ALL STEEL)

HANGAR (all steel) 131ft overall span x 150ft to 250ft long, clear opening 119ft 6in wide x 27ft 6in high. Doors both ends (gable end optional). Covered asbestos or steel sheets. Glazing in sides.

HANGAR (all steel). 212ft 6in overall span x 150ft to 250ft long, clear opening 200ft wide x 40ft high. Doors both ends (gable end optional). Covered asbestos or steel sheets. Glazing in roof and sides; 20ft span annexes on one or both sides if required.

ROMNEY HUTS. Suitable for airfield stores or offices. Curved buildings 35ft span, covered corrugated steel sheets. Ends as required; ex-stock.

BELLMAN HANGARS, LTD.,
TERMINAL HOUSE,
GROSVENOR GARDENS,
London, S.W.1.
Grams: Unitstruct, Sowest, London. [0980

PACKING AND SHIPPING

R. AND J. PARKS, Ltd., 143-9, Fenchurch St., E.C. Tel.: Mansion House 3093. Official packers and shippers to the aircraft industry. [0012

PATENTS

THE proprietor of British Patent No. 617067, entitled "Flexible Insulating Pads," offers same for licence or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern and Carlberg, 14 East Jackson Boulevard, Chicago 4, Illinois, U.S.A. [9485

WHAT IS A CONSULSHIP?

The answer to this all depends where you are.

If you happened to be in Ancient Rome, and were offered a Consulship, you would turn into a big-wig right away, and become Chief Magistrate. This would probably bring with it all sorts of perquisites including gold braid on your toga and a few bundles of Christians to throw to the lions.

On the other hand, the present-day British Consul gets some pretty trimmings too—including two kinds of Union Jack, one for "Consuls Ashore" and the other for "Consuls Afloat", but there doesn't seem to be anything for "Consuls Airborne" so far as we know.

For those who are interested in flying Consuls, however, we can offer this most attractive aircraft

which is finished in silver, with a Tropical White Top. It has six passenger seats upholstered in grey leather, and is equipped with Plessey 6-channel VHF with direct control permitting crystals to be changed in flight. The engines have run 757 and 850 hours respectively since complete overhaul, and the machine is in first-class condition, having been maintained for scheduled airline service until the C. of A expired in early April. It can, of course, be supplied with a new certificate when purchased, if desired.

A large quantity of spares are available with this aircraft for an inclusive (and very reasonable) figure.

H.P. terms could be arranged for U.K. operators.

PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned application to operate a scheduled air service:—

APPLICATION No. 190. From **East Anglian Flying Services Ltd.**, of Southend Airport, Southend-on-Sea, Essex, for additional on demand traffic stops at Portsmouth and Bournemouth on their Normal Scheduled Service, on the route Southend-Rochester-Shoreham-Jersey (Application No. 4), recently approved by the Minister of Civil Aviation. The Company also ask to be allowed to operate the service with DH.89 and possibly with DH. Heron or Dakota aircraft. An earlier application (No. 189) for revised frequencies and on demand traffic stops at Alderney and Guernsey on this service was advertised on 10th April, 1953.

THIS application will be considered by the Council under the Terms of Reference issued to them by the the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to this application must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 9, Buckingham Gate, London, S.W.1, from whom further details of the application may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, must reach them within the period allowed for the making of representations or objections. [9557

RADIO WANTED

WANTED, multi-channel V.H.F. radio, suitable light aircraft.—6, The Avenue, Middlesbrough. [9549

TIME RECORDERS

STAFF item checking and job-casting time recorders (all makes) for quick cash sale; exceptional condition. —Box 7241. [0040

TUITION

AVIGATION OF EALING

WE have pleasure in announcing that Mr. W. V. Canton, F.R.Met.S., M.I.N., has now joined the directive staff and he invites all his old and new friends to contact him at the address given below.

DETAILS of courses for all the private and professional Pilot's Licences (including Flight Navigation) will be forwarded on application. Direct tuition, with continuous lectures in progress, are at 5 guineas per week and "Guided Study" at 3 guineas per week. A maximum fee is laid down for each particular licence and once a student has paid this amount all further tuition is free. If a student completes study in a lesser period of time than that comprising our set courses, the 5-guinea rate will apply. These maximum fees are:—

	Ab initio	*Previous experience*
C.P.L. and I.R.	£50	30 guineas
Senior Commercial ...	£95	60 guineas
A.L.T.P.	£130	70 guineas
S.C.-A.L.T.P. (Conversion)		20 guineas
Flight Navigation ...	£190	120 guineas

(Bespoke printed, with up to eight colour illustrations; lecture notes are issued concurrently with the Direct Tuition.)

POSTAL courses, which include marking of answer-papers and Guidance Master-Answers, are also available in our usual high-grade printing with profuse illustration in up to eight colours.

THE phenomenal successes achieved by our students and comments received from all quarters of the globe, lead us to believe that these courses are the finest in the world. Sample supplied gratis.

GENERAL and Specific A.R.B. instruction is available only under the Direct Tuition system and once again we have an almost 100 per cent. record of "first attempt" passes.

AVIGATION, LTD.
30 CENTRAL CHAMBERS, EALING BROADWAY,
LONDON, W.5.
(Ealing 8949). [0248

TWIN CONVERSIONS

GEMINI aircraft, fitted radio, £6 per hour, dual or solo.—Southend Flying School, Essex, Rochford 56204. [0333

THE LONDON SCHOOL OF AIR NAVIGATION

OFFERS a distinct possibility for a career in Civil Aviation. Our personal coaching methods are unsurpassed. This is by far the more economical, as one qualifies quicker, therefore becomes employable sooner. Our staff are all experienced pilot/navigators. Full-time tuition arranged to suit individual students depending on their requirements. Generally speaking, six weeks should be allowed for the C.P. and I/R; three months Senior Com; four months A.L.T.P.; six months Flight Navigator. Ante-date commencement appropriate time. Employers expect highest possible qualification before offering appointments. Fees 5 gns. per pupil week; all books and equipment loaned. Considerable reduction long-term booking or previous client. Conversion courses.

WE are also revising and refreshing our "Study-as-you-work" courses, whilst adopting a very attractive presentation. These are the only courses of their kind which give full coverage of the syllabi. First groups available in April, the remainder following in quick succession. Our results are of a high order and we obtain by far the majority of passes in the country. Our teaching is to M.C.A. application of I.C.A.O. standards. Assistance as to employment.—Write for brochure and advice without obligation. All link practices with R/T for Instrument Procedures; also Consul Instrument Flying (shared); Type Ratings (A.R.B.); co-ordinate all your training requirements under our direction.

33 OVINGTON SQUARE, Knightsbridge, London, S.W.3. Tel.: KEN. 8221. [0277

AIR SERVICE TRAINING OF HAMBLE provides training in all branches of aviation in their flying, navigation, radio and engineering schools.

DETAILS of the numerous ab initio and conversion courses available will be forwarded on application to the Commandant, Air Service Training, Ltd., Hamble, Southampton. [0070

LEARN to fly for £24; instructors' licences and instrument flying for £3 per hour; night flying £3/10/- an hour; residence 5 gns. weekly. Approved M.C.A. private pilot's licence course.—Wiltshire School of Flying, Ltd., Thruxton Aerodrome, Andover, Hants. [0253

A. F.R.Ae.S., A.R.B.Certs., A.M.I.Mech.E., etc., on "no pass no fee" terms; over 95% successes. For details of exams and courses in all branches of aeronautical work, navigation, mechanical eng., write for 144-page handbook free.—B.I.E.T. (Dept. 702), 17, Stratford Place, London, W.1. [0707

Air-minded service *for* car-minded air men

Everybody in aviation who wishes to purchase a car or sell one is welcome, and well advised, to use the service now provided by HENLYS Aviation Industries Department. Advice and assistance are readily forthcoming on :—

- ***NEW CARS*** — an unequalled choice for immediate delivery.
- ***USED CARS***—the finest selection of guaranteed used cars in the country.
- ***PART EXCHANGE***—Your car taken in part exchange.
- ***PURCHASES***—for cash.
- ***TERMS*** — convenient deferred terms if required.

Please complete and send form below.

HENLYS AVIATION INDUSTRIES DEPARTMENT

Caters expressly for the motor transport needs of aircraft manufacturers, airline and airport operators, charter services and flying clubs and specializes in the supply of

TRANSPORT FLEETS . COMMERCIAL VEHICLES . FIRE & CRASH WAGONS MECHANICAL HANDLING VEHICLES

'Phone, write or call

HENLYS

England's Leading Motor Agents

AVIATION INDUSTRIES DEPARTMENT

Henly House, 385 Euston Road, London, N.W.1

(Euston 4444)

Cut out and post to HENLYS Aviation Industries Department

(*Address as above*)

I am interested in a NEW/USED*

Make ..... H.P.....

**Strike out whichever does not apply.*

I have for Part Exchange:

Make..... H.P.....

First reg..... Milge.....

Body Style .....

Name .....

Address .....

.....

.....

Telephone .....

(*No obligation whatsoever involved*)

TUITION

AERONAUTICAL, automobile or agricultural engineering. Practical full-day workshop training with graded technical courses for students with or without G.C.E. Short pre-call-up or refresher courses. Syllabus from Engineer-in-Charge, College of Aeronautical Engineering, Sydney Street, Chelsea. Flaxman 0021. [0019

FREE! Brochure giving details of courses in all branches aero eng., covering A.F.R.Ae.S., A.R.B.Certs., M.C.A. exams., etc. We are the only postal training college operated by an industrial organization.—Write to E.M.I. Institutes, Postal Division, Dept. F.26, 43, Grove Park Rd., London, W.4. (Associated with H.M.V.) [0926

SOUTHEND-ON-SEA MUNICIPAL FLYING SCHOOL, Essex. Tel.: Rochford 56204. Comprehensive training for private, commercial licences and instructors' endorsements. M.C.A. approved for 30-hour course. Tiger Moth and Auster aircraft fitted with radio. Special facilities for training in instrument ratings. Hourly rates: solo, day £3, night £4. Dual 5/- extra. Contract rate £2/10/-. Link trainer 10/-. No fees or subscriptions. Trial lesson, 30/-. [0332

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

VICKERS-ARMSTRONGS, Ltd. (Aircraft Section), have vacancies at their Hurn branch (near Bournemouth, Hants) for the following staff:—

DESIGN DRAUGHTSMEN
(aircraft experience preferable, but not essential).
SENIOR AIRCRAFT ELECTRICAL DRAUGHTSMEN.
AIRCRAFT STRESSMEN.
SENIOR AND JUNIOR WEIGHTS ENGINEERS
(for aircraft work in design office).
JIG AND TOOL DRAUGHTSMEN.

APPLY in writing to the Employment Manager, Vickers-Armstrongs, Ltd. (Aircraft Section), Weybridge, Surrey.

APPLICATIONS, with certain exceptions, are subject to the approval of the Ministry of Labour and National Service. [9547

KINGSTOWN AIRPORT, CARLISLE

THE Corporation invite applications for the tenancy of the above by a tenant experienced in airport administration and able to provide charter and other air services. Further particulars on application.

H. D. A. ROBERTSON,
TOWN CLERK,
15 Fisher Street,
Carlisle. [9563

STRESS ENGINEERS.

SAUNDERS-ROE, Ltd., require the services of a limited number of qualified stress engineers to work on an interesting and intensive programme on advanced types of aircraft. This is work of national importance in congenial surroundings, and the company will be able to assist successful applicants to find suitable accommodation. Good salaries will be paid to men of proved ability and experience.—Inquiries will be welcomed by the Chief Designer, Saunders-Roe, Ltd. (Ref. F/C 6), Osborne, East Cowes, Isle of Wight. [9556

EAGLE AVIATION, Ltd.

HAVE vacancies in the following categories:—

(1) Captains and first officers, preferably with Viking and/or Dakota ratings.
(2) Radio officers with full M.C.A. licence.
(3) Engineers with "A" and "C" licences covering Viking and/or Dakota aircraft—willing to undertake occasional flying duties.
(4) "X" licensed engineers covering instruments, electrics.

APPLICANTS should write in the first instance, giving details of experience and availability to: Operations Manager, Eagle Aviation, Ltd., Blackbushe Airport, Camberley, Surrey. [9482

SILVER CITY AIRWAYS.

VACANCY exists in approved instrument laboratory for skilled instrument mechanic.

WRITE for interview, all expenses will be paid, to: Engineering Superintendent, Blackbushe Airport, Camberley, Surrey. [9524

SILVER CITY AIRWAYS, Ltd.

APPLICATIONS are invited from experienced A and/or C licensed engineers for ground and flying duties. Preferably, but not essentially, endorsed for Bristol 170 Hercules engines.

WRITE for interview, all expenses will be paid, to: Engineering Superintendent, Blackbushe Airport, Camberley, Surrey. [9590

COMMERCIAL pilot wanted; Auster endorsement; pleasure flights and occasional charter, duration summer season.—Pine's Airways, Ltd., Blackpool Airport. [9561

SKYWAYS of London have a limited number of vacancies for captains with York experience.—Please write or telephone full particulars to the Personnel Manager, 7, Berkeley Street, London, W.1. [9559

LICENSED radio engineer and radio mechanics at our base at Stansted Airport, Essex.—Apply by letter or telephone to the Senior Radio Engineer, Aviation Traders, Ltd., Southend Airport, Essex. Tel.: Rochford 56491. [9560

AIRCRAFT or mechanical draughtsmen required, all grades.—Apply, stating age, experience and salary required, to the Chief Draughtsman, Alan Munts and Co., Ltd., Aircraft Division, Langley Aerodrome, Slough, Bucks. [9568

TECHNICAL illustrator required, aged 23 or over, with considerable practical experience.—Applications in writing to Personnel Manager, Percival Aircraft, Ltd., Luton Airport, Beds, stating age, experience and salary required. [9565

A LARGE aircraft company in the North of England have an immediate vacancy for a chief production engineer in the 40/45 age group, who would be responsible to the general works manager for the following departments:—

PLANNING, ratefixing, jig and tool design, progress.

PREVIOUS experience in a similar capacity with a major aircraft company is considered essential. Replies, which will be treated in the strictest confidence, should give full details of past experience and salaries earned.—Write Box F.215, c/o 191, Gresham House, E.C.2. [9534

WESTLAND AIRCRAFT, Ltd., Yeovil, Somerset, require stressmen, junior and intermediate draughtsmen, spares compiler and technical writer. Applications, stating age, experience and salary required should be addressed to Personnel Officer. [9530

THE DE HAVILLAND AIRCRAFT COMPANY LTD.

have VACANCIES for:

Technical Authors
Technical Illustrators
Spare Parts List Compilers

who must have general knowledge of aircraft and be capable of reading engineering drawings to compile Servicing Manuals for Civil and Military Aircraft

Apply in writing stating qualifications, age and approximate salary required, to:

CHIEF DRAUGHTSMAN,
THE DE HAVILLAND AIRCRAFT COMPANY Ltd.
HATFIELD, HERTS

DRAUGHTSMEN

AERODYNAMICISTS
STRESS ENGINEERS
WEIGHT ENGINEERS

Join a progressive and expanding organisation.

Work on an intensive programme of research and development on advanced types of aircraft.

Be employed on work of national importance.

Live in the warmer, healthier climate of the Isle of Wight.

Housing facilities available.

Good opportunities for technical training.

First class recreational facilities.

Arrangements will be made to interview applicants in their home area, and for selected personnel to visit the Isle of Wight with expenses paid. Apply, stating age, qualifications, experience, salary, etc. to:

The Personnel Office (Dept. F/C5)

SAUNDERS ROE LTD
COWES ISLE OF WIGHT.

A. V. ROE
CANADA LIMITED

Require

SENIOR STRESSMEN

SENIOR DRAUGHTSMEN

SENIOR AERODYNAMICISTS

STRUCTURAL & SYSTEMS TEST ENGINEERS

FLIGHT TEST ENGINEERS

The Company is foremost in progressive aircraft and engine design and manufacture in Canada, and is at present engaged on a comprehensive programme for the

R.C.A.F.

Applicants desirous of immigrating to Ontario should call or write

Dept. A.2.
ONTARIO IMMIGRATION DEPARTMENT
12 NEW BURLINGTON STREET
LONDON W.1.

RAPIDE PASSENGER SEATS
Brand new. Grey leather upholstered, complete with lap straps. Released
£8 EACH
MUIR & ADIE LTD.
Croydon Airport, Surrey, England
Grams: Muirair, Croydon. Phone: CRO 1744.

COTTON BAGS
FOR SPARE PARTS, ETC.
WALTER H. FELTHAM & SON, LTD.
Imperial Works, Tower Bridge Road,
Telephone: HOP 1784 **LONDON, S.E.1**

SITUATIONS VACANT

SERVICE engineers required for installation, flight testing and servicing of aircraft navigational and auto-pilot equipment.

APPLICANTS must be prepared to travel. Essential to have sound knowledge of radio and electronic principles and practice, preferably to C. and G. Radio III standard.

GOOD conditions. Pension scheme. Apply with full details, including salary and quoting No. 1087 to Personnel Manager, Sperry Gyroscope Co. Ltd., Gt. West Road, Brentford, Middx. [9525

THE DE HAVILLAND ENGINE Co., Ltd., have the following technical vacancies available at their Hatfield factory:—

SENIOR TECHNICAL ASSISTANTS. Senior personnel with at least an honours degree are required in a laboratory engaged on gas turbine components research and development. An intimate knowledge of aerodynamics or thermodynamics and heat transfer is required, together with considerable practical ability. Experience of experimental techniques connected with gas-flow combustion and turbine and compressor testing would be an advantage.

JUNIOR TECHNICAL ASSISTANTS. Technical assistants are required in a laboratory engaged on gas-turbine components research and development. They should be of at least Higher National standard, with a preference for a degree and with some knowledge of either thermodynamics, aerodynamics or heat treatment. Practical ability is essential and experience of experimental techniques connected with gas flows, combustion or the testing of compressors and turbines would be an advantage.

GOOD salaries and prospects to suitable applicants, good canteen facilities, 5-day week.—Please write in confidence, giving age, full details of previous experience and salary required, to the Personnel Officer, The de Havilland Engine Co., Ltd., Hatfield Aerodrome, Hatfield, Herts. [9552

BRITISH OVERSEAS AIRWAYS CORPORATION invite applications for the post of assistant engineering manager, repair factories, based at Treforest, South Wales.

THE successful applicant will be responsible to the engineering manager, repair factories, for:—
The day-to-day supervision and co-ordination of the engineering sections directly concerned with the overhaul of engines, propellers, components and accessories, viz. production (including test), planning and inspection.
He will also act as deputy to engineering manager.

CANDIDATES should be not over 45 years of age and should possess a recognised engineering degree and not less than 15 years' practical experience in the overhaul and/or production of aero engines, including experience in a managerial capacity in this field. Experience in the manufacture of aero engines and in the manufacture/overhaul of gas turbines will be considered an advantage.

THE appointment will carry a salary of £1,400 per annum with good prospects.

APPLICATIONS should be submitted in writing to the Chief Personnel Officer, British Overseas Airways Corporation, Airways House, Great West Road, Brentford, Middlesex. [9558

URGENTLY required by engineering firm of repute in north-west district, plant and equipment draughtsman, used to general maintenance work, plant layout and services. Must be capable of working on own initiative. —Apply, Box A199. [9248

SENIOR and intermediate design draughtsmen, with good experience of aircraft, or light structural or mechanical engineering, required for aircraft and armament project work.—Apply by letter to Portsmouth Aviation, Ltd., The Airport, Portsmouth. [9260

DESIGN draughtsmen with degree or Higher National Certificate, to work in small team on rocket motors. Excellent opportunity to gain experience in mechanical, pneumatic, hydraulic and combustion engineering. Reference EGDA2.

DEVELOPMENT engineers with degree or Higher National Certificate, for work on fuel system and controls, general engine development, defect investigation and performance analysis on gas turbines. Seniors and juniors wanted. Reference JM2.

SENIOR engine designer, 30-36 years, for work of exceptional interest on an entirely new design project offering wide scope for imagination and inventiveness. Highly-trained man with thorough knowledge of high speed IC engine design with at least Higher National Certificate or preferably degree. This is an exceptional job for a mechanical designer of outstanding quality. Reference HSR2.

TECHNICIANS with degree in mathematics or engineering for Stress Department working on strength investigations and calculations on gas turbine aero engines, also a few vacancies in same department for work on installation and mounting of gas turbines in aircraft. Reference DRE3.

DESIGNER draughtsmen for interesting work on design and detail of gas turbine test equipment for research, experimental and production projects from initial engine build to component and final testing. Good salaries to experienced men able to work on own initiative. Reference B.3.

DESIGNERS and senior and junior draughtsmen for gas turbines. Suitable qualified draughtsmen will be trained. Reference F.104.

DESIGNERS and detail draughtsmen for engine installation work on latest type aircraft. Reference WHF2.

EXPERIENCED INSTRUCTOR for Gas Turbine School. Knowledge aero engines and gas turbines essential. Reference RC2.

TECHNICAL assistant interested in flight development of gas turbines. Engineering degree or similar standard needed for work on all aspects of engine performance prediction, flight analysis, and associated problems on turboprops and turbojets. Reference B82.

TO help with calculation work on gas turbines, junior female assistants required. Interest and ability in mathematics to School Certificate standard. Scope here to extend scientific knowledge. Reference WB6.

JUNIOR female assistants for photographic recording required. No experience necessary. Reference WB5.

APPLICATIONS to Personnel Manager, Armstrong Siddeley, Coventry. [9568

JIG and tool draughtsmen, fully experienced, required by Percival Aircraft, Ltd., Luton Airport, Beds. Good working conditions and full welfare facilities, including staff pension scheme.—Applications to the Personnel Manager, stating age, experience, salary required. [0600

ESTIMATOR required with sound knowledge of aircraft components, airframe assembly and details, and associated machine-shop work.—Apply in writing, stating experience and salary required, to Personnel Manager, Flight Refuelling, Ltd., Tarrant Rushton Airfield, Nr. Blandford, Dorset. [9542

DESIGNERS, draughtsmen and modification draughtsmen, technicians, technical writers, technical illustrators, technical assistants, spares compilers and stressmen required for pressurizing, high altitude breathing, etc. Fully detailed applications with salary required to Personnel Officer, Normalair, Ltd., Yeovil, Somerset. [9529

DOWTY EQUIPMENT LIMITED

require first class sound

PRACTICAL ENGINEERS

preferably with some experience of design, development and testing of jet engine accessories, particularly flow, acceleration and speed governing controls, burners and pumps. Exceptional prospects of advancement.

SENIOR DRAUGHTSMEN

required for development work on fuel systems. Experience on light hydraulic or pneumatic controls acceptable.

SENIOR DRAUGHTSMEN

for hydraulic and undercarriage department also required.

JIG & TOOL DRAUGHTSMEN
STRESSMEN AND
TECHNICAL WRITER

Important positions with prospects.

The Company's conditions are exceptionally good. There is a realistic pension scheme and the environment is ideal.

The Company employs a Housing Officer who will render every assistance.

Write, preferably in tabulated form, to

PERSONNEL MANAGER,
DOWTY EQUIPMENT LTD.
CHELTENHAM

VICKERS-ARMSTRONGS LIMITED

SOUTH MARSTON WORKS, SWINDON

have vacancies for

DRAUGHTSMEN

(Senior and Junior).

Applications are invited from men preferably with some previous aircraft experience, but applicants with mechanical, structural and electrical experience also considered.

The work is interesting, is on the latest aircraft development, and is of high priority.

Excellent working conditions.

PENSION SCHEME.

Recommendation for housing after short probationary period.

Apply, in confidence, giving full details including salary required, to:

PERSONNEL DEPT.,

VICKERS-ARMSTRONGS LTD.
SOUTH MARSTON WORKS
SWINDON, WILTS.

SITUATIONS VACANT

STRESSMEN-DESIGNERS offered up to £900 per annum. Degree standard with minimum five years' stressing experience on interesting project in expanding office in well-known South of England firm. Please send full particulars to Box AC.80348, Samson Clarks, 57-61, Mortimer Street, London, W.1. [0631

H. M. HOBSON, Ltd., invite applications for positions in the drawing office as follows: designers, detail and modification draughtsmen, checkers, stressmen. The work is concerned with interesting projects connected with fuel metering equipment and hydraulic flying controls for aircraft.—Hobson Works, Fordhouses, Wolverhampton. [0420

URGENTLY required by engineering firm of repute in north-west district, draughtsman with experience in the design of rigs and testing fixtures as applied to internal combustion engineering. Only those with experience and who can design and work on their own initiative need apply.—Apply: Box 5198. [9247

TECHNICAL assistants are needed by D. Napier & Son for interesting development and testing work in the elevated temperature laboratory. Essential qualifications are mechanical engineering apprenticeship and H.N.C. Write, quoting Ref. 456, to Central Personnel Services, English Electric Co., Ltd., 336/7, Strand, London, W.C.2. [9546

SHEET metal technician required for important development work on gas turbines in London district. Must be conversant with metal forming and press work on small components, particularly in stainless steel. Able to prepare own layouts and advise on tooling. State age, experience and salary required.—Box No. AC80982, Samson Clarks, 57-61, Mortimer Street, London, W.1. [9553

APPLICATIONS are invited from senior and intermediate design draughtsmen. Experience of aero-engine design desirable, but not essential. Also checkers. —Please write, stating age, and giving details of previous experience in chronological order, to the Personnel Officer, The de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middlesex. [0630

REQUIRED immediately by Percival Aircraft, Ltd., Luton Airport, Beds, several draughtsmen with comprehensive experience of engine installations and allied systems. Good welfare facilities, including staff pension scheme.—Applications in writing, stating age, qualifications, experience and salary required to the Personnel Manager. [0601

BRITISH EUROPEAN AIRWAYS require engine, airframe and electrical engineering instructors at Northolt. Engineering apprenticeship, five years' aircraft maintenance experience, "A," "C," or "X" licence standard. Salary scale, £570-£785 p.a.—Written applications to Personnel Officer, Flight Operations, B.E.A., Keyline House, Ruislip, Middlesex. [9564

TEST laboratory assistants (male) required by Percival Aircraft, Ltd., Luton Airport, Beds. National Certificate standard and previous experience on design of test laboratory equipment desirable. Good welfare facilities including staff pension scheme.—Applications, stating qualifications, experience, age and salary required, to Personnel Manager. [0596

ARMSTRONG SIDDELEY require a first-class mechanical designer, aged 26-32, for their project design office. Applicants must be works trained designers with at least Higher National Certificate and a sound background experience of aero engine design. The position offered is one of great interest and is an exceptional opportunity for a young engine designer to expand his experience in the gas turbine industry.—Reply, in detail, to Reference HSR.3, Personnel Manager, Armstrong Siddeley Motors, Coventry. [9543

GROUND STARTING EQUIPMENT

Ex Stock—Heavy Duty Trolliac Cables. Immediate Delivery. 15ft, £8. Trolliac Plugs, British, £6 10s. U.S.A./British, 2/3 Way Adaptors, £7 10s.

Staravia

BLACKBUSHE AIRPORT

CAMBERLEY, SURREY

Tel.: Camberley 1600

A. V. ROE CANADA LIMITED

REQUIRE

1. **TECHNICAL ILLUSTRATORS** with five or more years' experience, preferably with aircraft company. Must be familiar with engineering drawings, clear pencil details, good eye for perspective, accurate inkers. Air brush experience an asset.

2. **TECHNICAL ILLUSTRATORS AND AIR BRUSH RENDERERS** with three or more years' experience. Thoroughly familiar with engineering drawings and specialising in air brush renderings of cutaways, etc. Good eye for perspective, general knowledge of colour use.

3. **TECHNICAL ILLUSTRATORS** with qualifications outlined above with up to three years' experience on actual illustration.

Applicants desirous of immigrating to Ontario should call or write:—

Dept. A.1

[ONTARIO IMMIGRATION DEPARTMENT

12 NEW BURLINGTON STREET

LONDON, W.1.

The . . .

British Air Line Pilots' Association

95 MOUNT STREET, W.1

Tel.: GROsvenor 6261

Membership open to all Commercial and Service pilots. For full details as to the objects and particulars of Membership please write to secretary.

SITUATIONS VACANT

AIR FORCE, naval, civil and helicopter aircraft all under design and development at Percival Aircraft, Ltd., Luton Airport, Beds. Applications are invited from senior and junior draughtsmen and stressmen for work on this interesting programme. Good welfare facilities, including staff pension scheme.—Write, giving details of experience and salary required, to Personnel Manager. [0595

CHIEF engineer required by aircraft accessory manufacturing company, to take charge of design office, laboratory and experimental departments. Essential to have had experience of both electrical and mechanical aircraft accessories. Salary £2,000 will be paid to right man. Pension scheme.—Apply, in strict confidence, stating age, education, details and dates of previous experience, to Box 6881. [9567

ARMSTRONG SIDDELEY MOTORS require senior engine designer, aged 30-36 years, for work of exceptional interest on an entirely new design project offering wide scope for imagination and inventiveness. Applicants must be first-class works trained mechanical designers with at least Higher National Certificate and a thorough knowledge of high speed I.C. engine design.—Reply, in detail, to Reference HSR.1, Personnel Manager, Armstrong Siddeley Motors, Coventry. [9542

FUEL system experimental engineer required by the Aircraft Division, English Electric Co., Warton, nr. Blackpool, to take charge of fuel system and fuel tank test, section. Qualifications required: a minimum of two years' experience on fuel systems or fuel system accessory testing. Ability to prepare test schedules and write concise reports. Degree or H.N.C. Apply, quoting Ref. 1115, to Central Personnel Services, Marconi House, 336/7, Strand, London, W.C.2. [9531

VACANCIES exist for several senior airframe stressmen for work on new designs. Men experienced in stressed skin construction and welded tubular frames required. Senior draughtsman for production design and installation work also required. Assistance given with housing accommodation for suitable applicants. Facilities for cheap flying with firm's flying club. Applications in writing stating age, experience and salary required, to the Chief Designer, Auster Aircraft, Ltd., Rearsby Aerodrome, Leicester. [9492

IMMEDIATE applications are invited for post as deputy head of electrical/radio office of leading aircraft company in the south. Applicant must have sound design experience, including aircraft, with specialist knowledge of installation of electrical, radio, radar and electronic instruments, and the development of ancillary apparatus. Applicant should be good disciplinarian. The post carries senior grading and housing can be recommended after a short probationary period.—Please write in first instance, giving experience and salary expected, to Box N.2006, A.K. Advertising, 212a, Shaftesbury Avenue, London, W.C.2. [9554

R. A. SHORT AVIATION

have for disposal from stock:—

150 GIPSY MAJOR ENGINES COMPLETE WITH MAGNETOS AND CARBURETTORS

From this stock we can supply as required — OVERHAULED — LOW HOURS or TIME EXPIRED

Also available

200 MAGNETOS AG4 and AG6 together with a large quantity of spares

All these items may be inspected at our stores

Please address enquiries to:—

R. A. SHORT AVIATION

Godstone Road, Whyteleafe, Surrey

Tel: UPLANDS 0391

IMPORTANT OPPORTUNITY

Chief Design Engineer

A prominent and well established originator and manufacturer of gas turbine aircraft engines requires a fully qualified man to assume complete technical and administrative responsibility for the design department

Include all useful information with application to

PERSONNEL MANAGER, BOX 6481 c/o "FLIGHT"

SLINGSBY SAILPLANES LTD.

CONTRACTORS TO H.M. GOVERNMENT

DESIGNERS AND MANUFACTURERS

OF

THE FAMOUS **"SKY"** SAILPLANE

The leading competition machine with performance and handling characteristics superior to any other sailplanes in production

AN ALL-BRITISH PRODUCT

SLINGSBY KIRBYMOORSIDE YORK

"PIONEERS OF BRITISH GLIDING"

SITUATIONS VACANT

APPLICATIONS are invited from design draughtsmen and stressmen, also technical assistants with combined design and performance experience for work on both reciprocating and gas turbine aero engines.—Applications should state full particulars of experience and qualifications and should be addressed to the Personnel Officer, the de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middlesex. [0002

ARMSTRONG SIDDELEY MOTORS, Coventry, have vacancies for a number of designers and senior and junior draughtsmen. Although gas turbine experience is most advantageous it is not necessarily essential, as training will be given in this specialized work to suitably qualified draughtsmen.—Apply, in detail, to Reference P.103, Personnel Manager, Armstrong Siddeley Motors, Coventry. [0200

SITUATIONS WANTED

ADMINISTRATIVE and technical engineer aged 43, A.M.I.Mech.E., A.F.R.Ae.Soc., M.I.Ae.Soc., M.I.P.E., desires change. Extensive background in automotive, aero engine and gas turbine design, manufacture and repair. Positions held: works manager, quality controller, production engineer and technical officer. Would consider home or overseas appointment. Salary expected, £1,500 p.a.—Box 6825. [9551

BOOKS

WRITE for our list No. 4, containing hundreds of aero books for sale.—From the aviation book specialist, Beaumont, 59 Russell Road, Forty Hill, Enfield, Middx. [9560

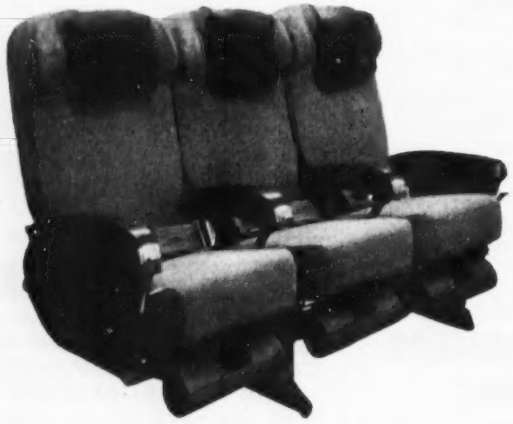
BOOKS

"YACHTING Quizzes," by Max A. Chappell. Packed with information on everything nautical from tides to trade winds, from fishing grounds to First Aid. A book every enthusiast must read. 3s. 6d. net from booksellers. By post 3s. 9d. from Iliffe & Sons, Ltd., Dorset House, Stamford St., London, S.E.1.

"MECHANICS for the Home Student," by Eric N. Simons, in association with W. D. Burnet, B.Eng., Lecturer in Mechanical Engineering at Sheffield University. The nineteen chapters of this practical book provide an excellent introduction to the subject under such headings as action, force, momentum, power, applied force, friction, centre of gravity, density, fluids, gases, heat, vibration, stress, impact, rotation, etc. 7s. 6d. net from all booksellers. By post 7s. 10d. from Iliffe & Sons, Ltd., Dorset House, Stamford St., London, S.E.1.

RUMBOLD

THE OLD ESTABLISHED AIRCRAFT FURNISHING SPECIALISTS



Adjustable High Density Treble Seats as fitted to Discovery Class Viscount Aircraft of B.E.A.

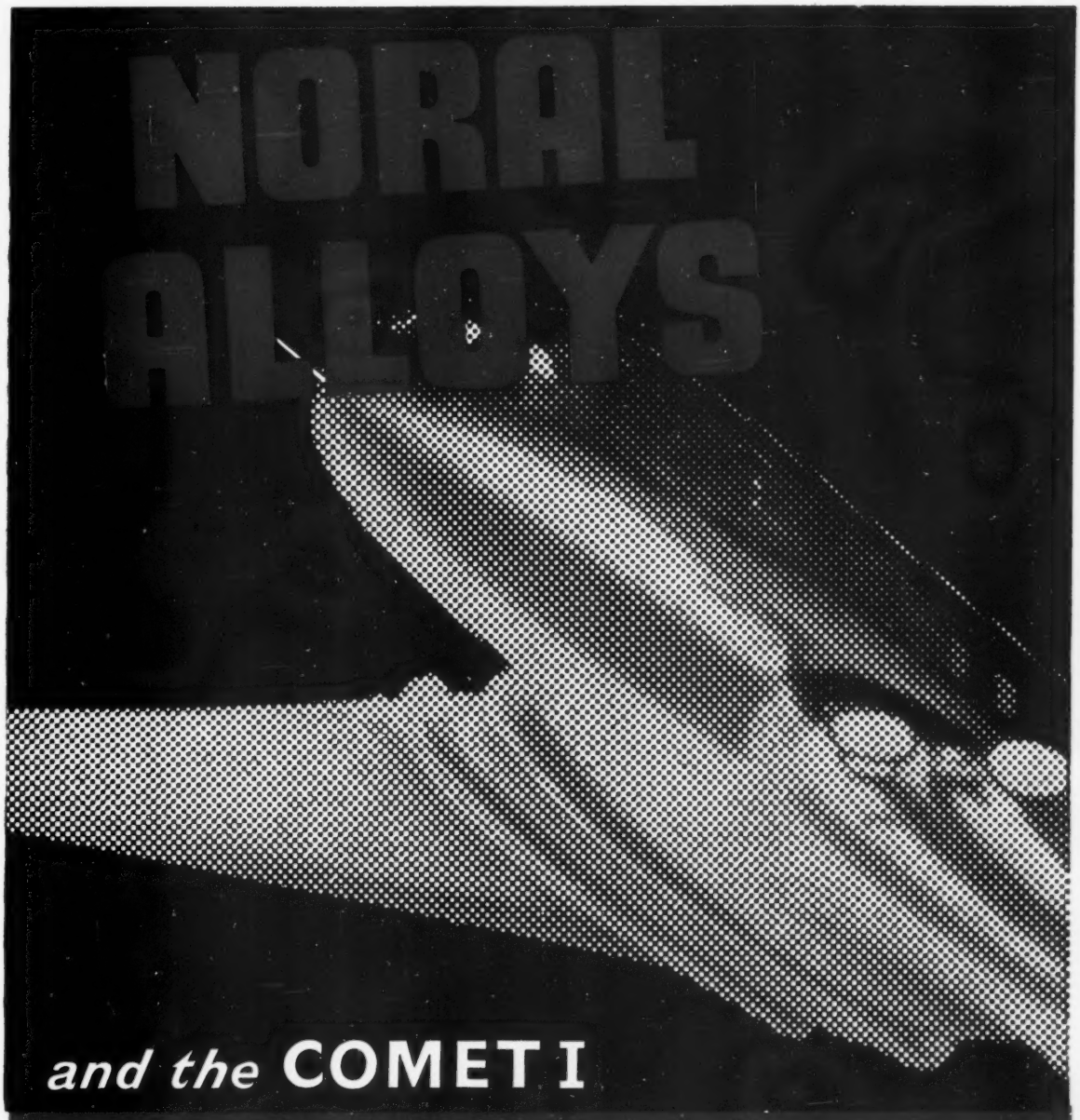
L. A. RUMBOLD & Co. LTD., KILBURN, LONDON, N.W.6

TELEPHONE: MAIDA VALE 7366-7-8

INDEX TO ADVERTISERS

	Page
Adcola Products, Ltd.	39
Aerocontacts, Ltd.	40
Air Industrial Developments, Ltd.	1
Airscrew Co. and Jicwood, Ltd., The	28
Alvis, Ltd.	21
Armstrong Whitworth Aircraft, Ltd., Sir W. G.	12
Aston and Co., Ltd., E. S.	31
Aviation Servicing, Ltd.	35
Aviation Traders, Ltd.	37
B. B. Chemical Co., Ltd.	31
Blackburn and General Aircraft, Ltd.	2
Bristol Aeroplane Co., Ltd., The	Cover iv
British Air Line Pilots' Association, The	43
British Messier, Ltd.	16
British Thomson-Houston Co., Ltd., The	3
Brown Brothers (Aircraft), Ltd.	4
Box No. 6481	
Carlisle and Co., Ltd., C. G.	38
Cross Manufacturing (1938), Ltd.	39
De Havilland Aircraft Co., Ltd., The	20, 41
Dowty Equipment, Ltd.	42
Dunlop Rubber Co., Ltd.	33
Esso Petroleum Co., Ltd.	18
Fairey Aviation Co., Ltd., The	Cover i, 19
Feltham and Son, Ltd., Walter H.	42
Frankenstein and Sons (Manchester), Ltd., P.	8
Gosheron and Co., Ltd., John	36
Habershon and Sons, Ltd., J. J.	32
Handley Page, Ltd.	24
Henlys, Ltd.	41
Jessop, Ltd., William	22
Kautex, Ltd.	34
Lambert Brothers, Ltd.	39
Lewis, Ltd., D.	39
Leytonstone Jig and Tool Co., Ltd.	31
Lincoln Electric Co., Ltd.	5
Lucas (Gas Turbine Equipment), Ltd., Joseph	13
Marconi's Wireless Telegraph Co., Ltd.	11
Mollart Engineering Co., Ltd.	32
Muir and Adie, Ltd.	42
Normalair, Ltd.	30
Northern Aluminium Co., Ltd.	Cover iii
Newton Bros. (Derby), Ltd.	36
Oldham and Son, Ltd.	37
Painton	17
Palmer Tyre, Ltd., The	6
Plessey Co., Ltd., The	14
Ratcliffe Tool Co., Ltd.	36
Redifon, Ltd.	27
Reed, Ltd., Austin	28
Robinson and Co. (Gillingham), Ltd., L.	34
Roe, Canada, Ltd., A. V.	42, 43
Rolls-Royce, Ltd.	38
R.M.R. Engineering	38
Rumbold and Co., Ltd., L. A.	44
Sangamo Weston, Ltd.	26
Saunders-Roe, Ltd.	41
Self-Priming Pump and Engineering Co., Ltd.	10
Shell-Mex and B.P., Ltd.	23
Short Aviation, R. A.	43
Slingsby Sailplanes, Ltd.	43
Smiths Aircraft Instruments, Ltd.	9
Sperry Gyroscope Co., Ltd.	Cover ii
Staravia	43
Stone and Co. (Charlton), Ltd., J.	7
Teddington Controls, Ltd.	26
T.I. Aluminium, Ltd.	15
Uhlhorn Brothers, Ltd.	38
Vickers-Armstrongs, Ltd.	29, 42
Vokes, Ltd.	34
Wiggin and Co., Ltd., Henry	25
Wolverhampton Aviation, Ltd.	39

Printed in Great Britain for the Publishers, ILIFFE & SONS LTD., Dorset House, Stamford Street, London, S.E.1, by SUN PRINTERS LTD., London, and Watford, Herts. *Flight* can be obtained abroad from the following: AUSTRALIA AND NEW ZEALAND: Gordon & Gotch, Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service, Ltd.; Gordon & Gotch, Ltd. SOUTH AFRICA: Central News Agency, Ltd.; Wm. Dawson & Sons (S.A.), Ltd. UNITED STATES: The International News Co. Entered as Second Class Matter at the New York, U.S.A., Post Office.



and the COMET I

British aircraft hit the headlines again and again, and the world sits up and takes notice. With all modesty we can claim some of the credit because our metallurgists and production engineers have co-operated for many years with the designers of Britain's best aircraft.

NORAL

Northern Aluminium

COMPANY LIMITED

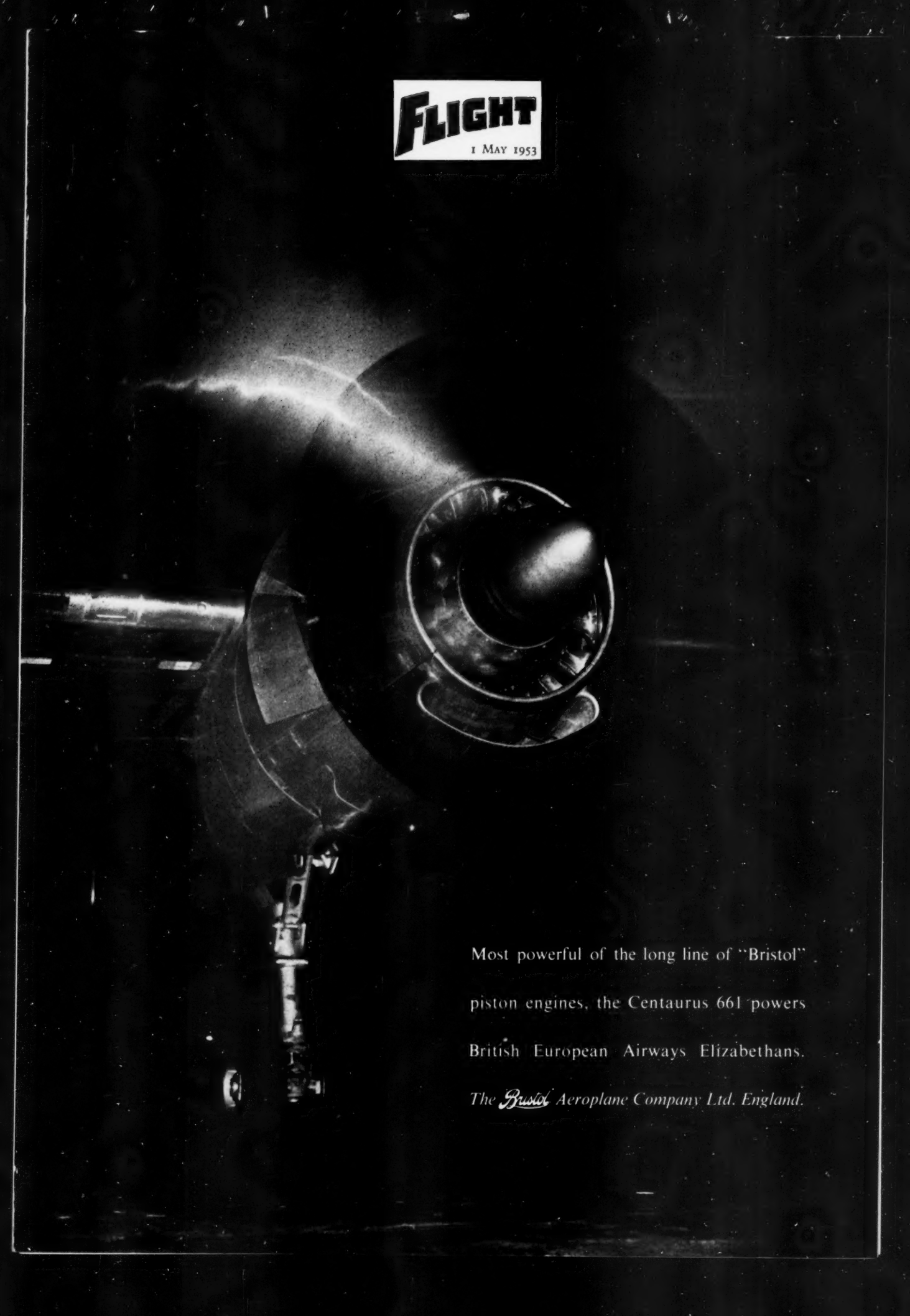
ALLOYS OF NORAL SHEET, STRIP, PLATE, SECTIONS, TUBING, WIRE, FORGINGS, CASTINGS, ALUMINIUM PASTE FOR PAINT.

SALES DEVELOPMENT DIVISION: EARLSBURY, OXON

SALES OFFICES: LONDON, BIRMINGHAM, MANCHESTER, BRISTOL, NEWCASTLE-ON-TYNE, LEEDS.

An ALUMINIUM LIMITED Company

FLIGHT
1 MAY 1953



Most powerful of the long line of "Bristol" piston engines, the Centaurus 661 powers British European Airways Elizabethans.

The Bristol Aeroplane Company Ltd. England.